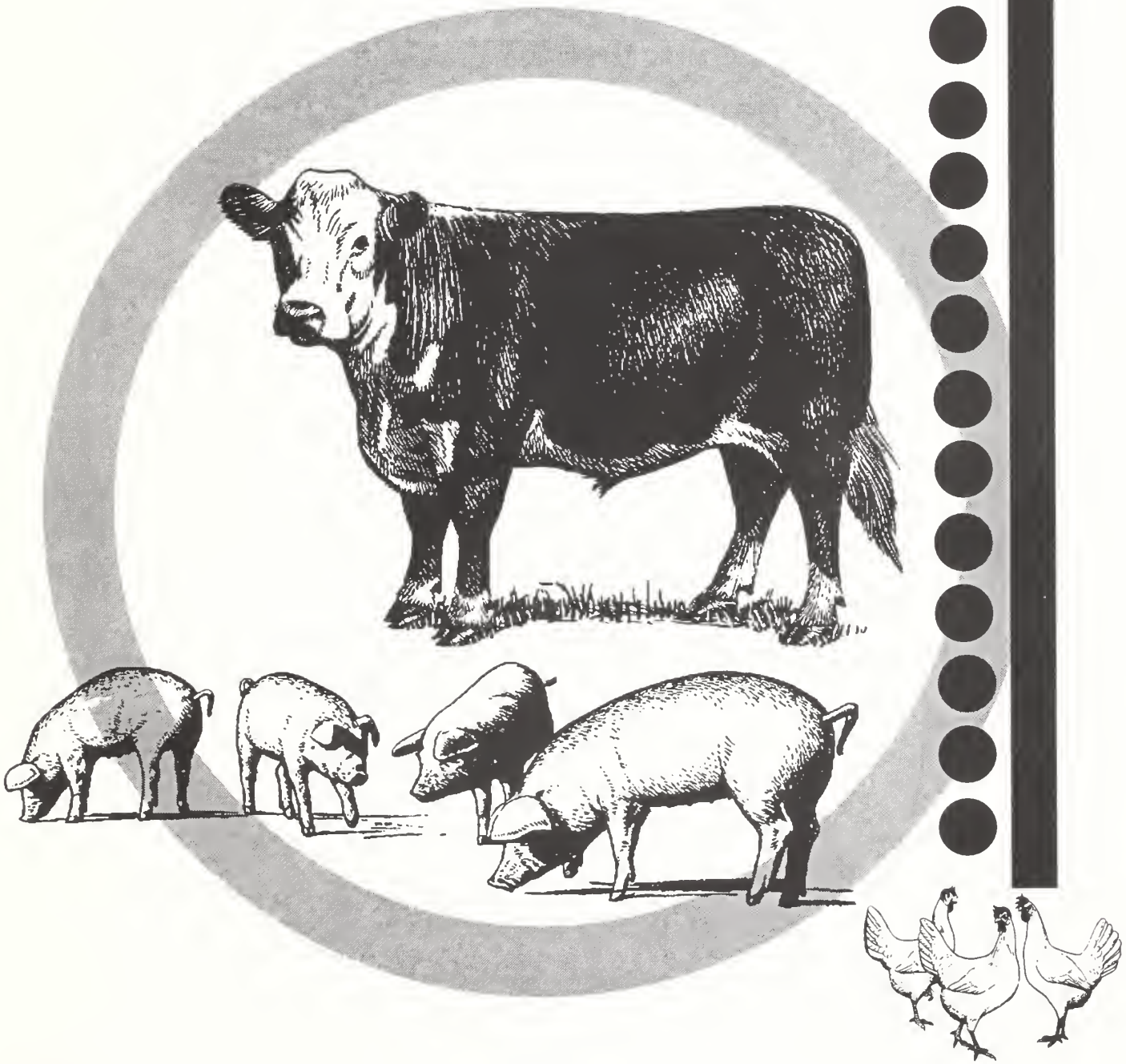
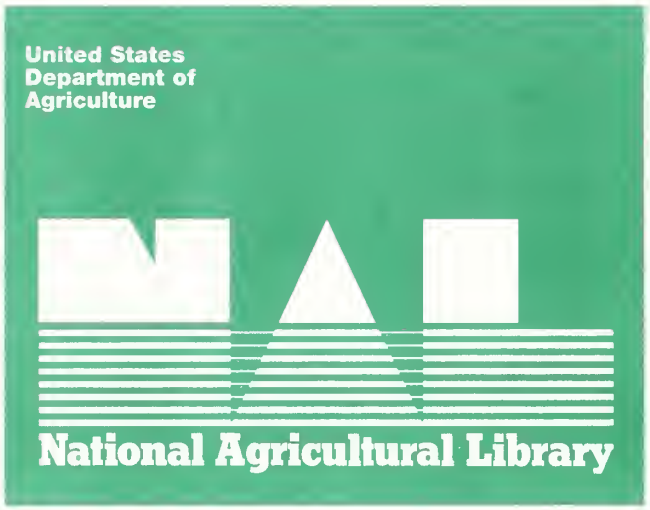
National Forum on Animal Production Food Safety

Proceedings-May 23-25, 1995

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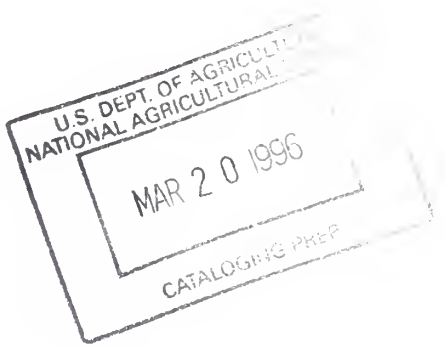
NATIONAL FORUM ON ANIMAL PRODUCTION FOOD SAFETY

May 23, 24, 25, 1995
College Park, Maryland



INTRODUCTION

These proceedings and summaries are intended to record and summarize the discussions and opinions expressed during the May 23-25, 1995, National Forum on Animal Production (preharvest) Food Safety. The synopses of audience discussions and workshop group presentations were developed from written transcripts of this meeting (Executive Court Reporters, Inc., telephone 301- 565-0064). Write-ups of the individual presentations were developed by the Animal Production Food Safety Program staff in conjunction with the presenters. Prior to submission for publication, these proceedings were submitted for review and comment to the individual presenters. Because of the critical nature of this document, it was essential that the respective representatives concurred on the accuracy of its contents.

Questions for the workshops were developed by the Animal Production Food Safety (APFS) staff in conjunction with the planning and advisory committee, which includes representatives from industry, academia, government, consumers, and animal health practitioners. (See "Acknowledgments" for a listing of members of the committee.) Questions posed to panels and speakers were submitted wholly by the audience/participants.

The purpose of this forum and workshops was to provide an open forum to discuss issues related to the animal production segment of the food safety continuum. We sought to build consensus and prioritize research needs and the roles and expectations of the various elements of the continuum as represented by the speakers. Within the scope of this forum, we discussed the current status of research and other initiatives in animal production that relate to food safety. Within each group, we discussed possible innovative and collaborative strategies to reach our stated needs in developing food safety strategies in animal production.

Participation included a wide range of representatives from the entire food safety continuum who engaged in frank discussions and collaboration as an integral part of the animal production food safety development process. Through this forum, we gained insight into the food safety and animal production needs and perspectives. This was truly an information-sharing, a innovation-developing, and bridge-building opportunity as we all turn our focus to collaborative efforts on mutual goals.

Mr. Michael R. Taylor
Administrator
Food Safety and Inspection Service
Acting Under Secretary for Food Safety
United States Department of Agriculture

Dr. Bonnie Buntain
Director
Animal Production Food Safety Program
Food Safety and Inspection Service
United States Department of Agriculture

ACKNOWLEDGMENTS

When the Animal Production Food Safety Program staff/team first thought it would be a good idea to hold a national forum to bring together leaders and representatives in animal production and representatives of all of the segments of the food safety continuum, few thought it would be possible to develop and hold a forum like this one in just under three months. The doubt was especially keen because the new APFS program had just been formed and transferred from the Animal and Plant Health Inspection Service (APHIS) to the Food Safety and Inspection Service (FSIS). We were a brand-new team, integrating into a new community and culture, and working out of packing boxes and with lap-top computers. However, this team was enthused with a can-do will-do attitude and dreams of making the new APFS program one that all stakeholders could support and one that would support all stakeholders.

The success of the national forum and the insights and cooperative bridges that developed are the products of lots of energy and patience from lots of dedicated and wonderful people.

The working groups and the planning committee were especially helpful, particularly in providing their professional expertise and guidance throughout the planning and development of the forum. When we could not meet together, we had conference calls, and we got the job done. These helpers and guides were Steve Sundlof and Gary Stefan, Food and Drug Administration, Center for Veterinary Medicine; Glen Slack, Livestock Conservation Institute; Robert Hahn, Public Voice for Food and Health Policy; Gary Weber, National Cattlemen's Association; Heather Klinkhammer, Safe Food Coalition; Mitchell Cohen, Centers for Disease Control; George Beran, Iowa State University; Tanya Roberts, United States Department of Agriculture, Economic Research Service; Dan Van Ackeren, USDA, Grain Inspection, Packers & Stockyards Administration; Robert Oltjen, USDA, Agricultural Research Service; Bob Buchanan, USDA, Food Safety and Inspection Service; William Wagner, USDA, Cooperative State Research, Education and Extension Service; Will Hueston, USDA, Animal and Plant Health Inspection Service; Brenda Halbrook, USDA, Food Safety and Inspection Service; Jill Hollingsworth, USDA, Food Safety and Inspection Service; Wes Towers, United States Animal Health Institute & Delaware Department of Agriculture; Patrick McCabe, United States Animal Health Institute; Richard Hoffman, Colorado Department of Health; Lester Crawford, Association of American Veterinary Medical Colleges; John Adams, National Milk Producers Federation; Leon Russell, Texas A&M University; Bennie Osburn, University of California, Davis; Jim McKean, Iowa State University; Charlie Stoltenow, Margaret Webb, Kris Murthy, Allan Hogue, and Ron J. Day, USDA-FSIS.

APHIS deserves special thanks for its constant help. Will Hueston was invaluable in providing linkage to APHIS' resources. We also owe APHIS a debt of gratitude for forging the way with the first pre-harvest food safety forum in March, 1994.

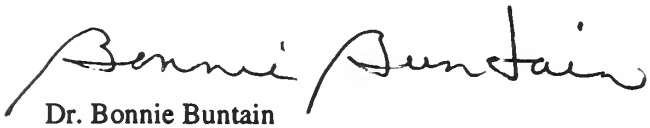
Expert facilitators contributed to the success of the nine research and commodity workshops. These were Asia Rial Elsbree, Julie Marquis, and Mike Tuck from APHIS, and Jerry Gettleman from FSIS. Stand-by alternates were Mike Caporaletti and Connie Williams, APHIS.

We also appreciate the help provided by the University of Maryland, University College, Inn and Conference Center. The conference center facility was, indeed, a fine place for our forum.

FSIS' Policy Evaluation and Planning staff helped with all of the practical details and we owe an enormous "thank you" to that unit, especially to Jennifer Callahan and Mary Gioglio.

Our very special thanks go to Kris Murthy and Margaret Webb of the Animal Production Food Safety Program. They were the team leaders for this forum.

And, as the saying goes, last but not least, "thank you" to all of you who attended, participated, and helped to make this forum one of learning, collaboration, and building. From this beginning, we can all go forward and work to develop strategies in a team-spirit to move toward our mutual goal of a safer and healthier food supply.



Dr. Bonnie Buntain
Director
Animal Production Food Safety Program
Food Safety and Inspection Service
United States Department of Agriculture

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United States Department of Agriculture

Food Safety and Inspection Service

Washington, D.C. 20250

APR 10 1995

Dear Colleague:

On May 23 - 25, 1995, the Food Safety and Inspection Service (FSIS) will hold the National Forum on Animal Production Food Safety. I hope you will join me at this important meeting.

We expect the Forum to play a major role in refining and advancing the FSIS strategy to assure the safety of meat and poultry products, from farm to table, as outlined in the Proposal for Pathogen Reduction; Hazard Analysis and Critical Control Point (HACCP) Systems, published in the *Federal Register* on February 3, 1995. Although the proposed regulation addresses product safety within a plant environment, FSIS recognizes that food safety requires attention throughout the chain of production, processing, distribution, and sale.

The primary focus of the Forum will be on the preventive approach to reducing microbial pathogens from the farm to the slaughter plant. Objectives are to define the current status of food safety risks and possible risk reduction measures in animal production practices, to work toward national consensus on research priorities, to identify partnerships needed for research and education, to recommend effective public/private funding processes to sustain research and build science-based prevention programs, to identify roles and responsibilities of stakeholders, and to make recommendations for the role FSIS Animal Production Food Safety Program should play. Several speakers will address key issues relating to HACCP, from farm to table, and international animal production food safety programs. In addition, attendees will participate in commodity workshops to reach consensus on pertinent topics relating to the Forum. Producers, processors, government agencies, consumer groups, university scientists, the veterinary community, and all interested groups are invited to participate.

The Forum will be held at the University of Maryland, The Inn and Conference Center, University College, College Park, Maryland. Each session will begin at 8:00 am and conclude at 5:30 pm on the first two days of the conference; day three will end approximately at 12:30 pm on May 25.

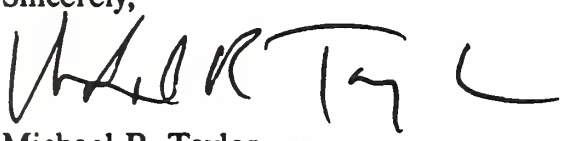
Dr. Bonnie Buntain, Director of the FSIS Animal Production Food Safety Program, will chair the Forum. I have asked her to provide leadership in the important task of defining the roles, responsibilities and strategy for animal production food safety within USDA's farm to table food safety initiative. This Forum will provide her team the necessary input to craft an effective science-based preventive program.

To reserve a space, please register by completing the enclosed registration form and sending it to the following address by May 5, 1995:

United States Department of Agriculture
Food Safety and Inspection Service/PEPS
Attention: Ms. Jennifer Callahan
14th and Independence Avenue, SW
Room 6904, Franklin Court
Washington, D.C. 20250
(202) 501-7136

I look forward to a successful Forum and hope you can join us at this most important meeting as we pursue our efforts to reduce foodborne illnesses from farm to table.

Sincerely,



Michael R. Taylor
Acting Under Secretary
for Food Safety

Enclosures

AGENDA

MAY 23, 1995 GENERAL SESSION

8:00 REGISTRATION

8:30 Introduction and Forum Goals
Dr. Bonnie Buntain, Director
Animal Production Food Safety Program

8:45 USDA/FSIS Food Safety Strategy and Role in APFS
Mr. R. Michael Taylor
Acting Under Secretary for Food Safety

9:05 Highest Risk to Human Health: Public Health Perspective
Dr. Eugene J. Gangarosa, Emory University

9:25 Perspectives on Farm to Table Food Safety Control Points
Dr. James Dickson, Iowa State University

9:50 - 10:05 BREAK

10:05 Application of Hazard Analysis Critical Control Points (HACCP) to Animal Production Food Safety
Dr. Merle Pierson, Virginia Polytechnic Institute and State University

10:30 An International Animal Production Food Safety Perspective - Netherlands and European Economic Community Directive
Dr. Jos Goebbels, Ministry of Public Health

11:00 Foodborne Diseases: Control of Salmonella Contamination in Foods of Animal Origin
Dr. Richard H. McCapes, American Association of Avian Pathologists

11:25 - 12:15 Questions & Answers

12:15 - 1:30 LUNCH

1:30 PANEL—Animal Production Technical Analysis Group Reports (AP-TAG)
Speakers to summarize what is known know about APFS risks and controls, including current important research.

1:30 Overview
Dr. James Marion/Dr. Bennie Osburn

2:00 Poultry
Dr. Peter E. Poss, University of Minnesota

2:30 Swine
Dr. Beth Lautner, National Pork Producers Council

3:00 - 3:15 BREAK

3:15 **Ruminants–Dairy/Veal**
Dr. Bennie Osburn, University of California - Davis
3:45 **Ruminants–Beef Cattle**
Dr. Fred Troutt, University of Illinois

4:15 - 5:30 Questions and Answers - AP-TAG Reports

MAY 24, 1995 SESSION II

8:00 Statement of Outcomes Expected for Day 2

8:15 Commodity Research Workshops: Poultry, Swine, Dairy/Veal, and Beef
An expert will summarize the current status of research for the first 20 minutes in each commodity breakout group. Topics to be addressed by each commodity breakout group:

8:45 1. Identify current research initiatives, gaps in scientific knowledge, and research priorities for on-farm, marketing, transport, and pre-slaughter preparation animal production food safety.
9:45 2. Suggest areas for highest priority research.
10:15 3. Review existing funding from both public and private sources.

11:00 Workshops Report Out (15 minutes each)

12:00 - 1:00 LUNCH

1:00 Commodity Animal Production Workshops: Poultry, Swine, Dairy/Veal, Beef
Topics to be addressed by each commodity breakout group:

1. Identify roles and responsibilities of various stakeholders from farm to table.
2. Identify partnerships needed for research and education to further implement residue and pathogen risk reduction (prevention) strategies from the farm to the processing plant.
3. Describe potential action plans for the Food Safety Inspection Service, Animal Production Food Safety Program and public/private strategies to support commodity efforts to implement food safety risk reduction practices.

Research Funding Workshop
Topics to be addressed by this breakout group:

1. Identify ways to assure adequate funding of focused, high-quality research in animal production food safety.
2. Develop practical options and suggestions.

4:00 - 5:30 Animal Production Workshops Report Out

MAY 25, 1995 Present/Future Perspectives and Recommended Action Plans

8:00 Introduction to Morning Panel
Dr. Bonnie Buntain and Mr. Michael R. Taylor

Topics to be discussed by each speaker: Based on the workshop recommendations and your perspective, describe what you believe is your shareholder's role, challenges, opportunities, and expectations.

8:15 Consumers
Ms. Donna Rosenbaum, Safe Tables Our Priority (STOP)

8:30 Packers
Dr. Jhung Colby, Perdue Farms, Inc.

8:45 Processors
Mr. Mel Coleman/Mr. Dan Montanari, Coleman Natural Meats
Dr. Dell Allen, Excel Corporation

9:00 USAHA/State
Dr. H. Wesley Towers, Jr., U.S. Animal Health Association

9:15 Market/Dealers
Ms. Nancy Robinson, Livestock Marketing Association

9:30 Veterinary Practitioner (Feedlot)
Dr. James E. Sears

9:45 Research Community
Dr. Jerry Gillespie, Kansas State University

10:00 Poultry—Eggs
Mr. Al Pope, United Egg Producers

10:15 - 10:30 BREAK

10:30 Poultry—Meat
Dr. Charlie Beard, Southeastern Poultry Assoc.

10:45 Turkey—Meat
Mr. Joseph Pocius, National Turkey Federation

11:00 Swine
Ms. Donna Reifschneider

11:15 Dairy/Veal
Mr. Jerrel Heatwole

11:30 Beef Cattle
Dr. Bob Smith

12:00 Panel Discussion

1:00 Closing Remarks
Mr. Michael R. Taylor

EXECUTIVE SUMMARY

This three-day Animal Production Food Safety Forum was convened on May 23, 1995, by the U. S. Department of Agriculture Acting Under Secretary for Food Safety, Mr. Michael R.Taylor. The purpose was to provide an opportunity for national leaders to build consensus among a diverse community of stakeholders on a science-based strategy for animal production food safety as an integral part of the farm-to-table food safety continuum. Mr. Taylor welcomed participants and charged the forum to develop animal production food safety strategies.

In order to provide the participants with a common knowledge base, experts presented overviews of health risks associated with contaminated animal products, perspectives on farm-to-table food safety control points, application of HACCP to animal production food safety, challenges of meat inspection in the Netherlands, and the control of Salmonella contamination in foods of animal origin. It was explained that "animal production" (preharvest) includes all live animal management practices from the farm, through marketing, transportation, pre-slaughter preparation and eggs transported to processing plants. "On-farm" means management practices limited to the farm.

An overview was provided of the Animal Production Technical Analysis Group (AP-TAG) Report to the USDA. The AP-TAG Report provided an assessment of human food safety hazards, risks, and controls through good management practices in the production of food animals. In-depth summaries were given by experts from the ruminant (including equine), pork, and poultry sections of the Report. The AP-TAG Report recommended that a risk-based approach be taken to animal production practices that incorporates HACCP principles for industry-driven, voluntary Quality Assurance Programs.

On May 24, commodity-oriented workshops focused on research concerns in dairy beef/veal, beef cattle, swine, and poultry/eggs. Common threads emerged, including the following: research funding should be borne by all stakeholders; collaboration and coordination of research are key; pre-slaughter interventions are a priority; rapid, cost-effective, standardized and accurate diagnostic tests are critical for progress in understanding pre-harvest food safety interventions; basic, clinical, applied and observational (monitoring and surveillance) research in live animals are all needed; and microbial ecology, animal management and handling practices, and epidemiology of animal populations are important. Every group agreed that there is a need to know whether changes in animal production practices translate to decreased public health risks for the consumer.

The May 24 afternoon commodity workshops considered farm to table stakeholders' roles and responsibilities, partnerships for research and education, and public/private strategies for industry-driven quality assurance programs for food safety risk reduction. The commodity groups believe that with the present science, foodborne pathogens carried in and on food animals cannot be eliminated at "control points" in live animal production. Industry is willing to collaborate and cooperate in efforts and research to reduce the risks of pathogens and to provide education about appropriate food safety practices. Animal commodity groups do not want a mandatory HACCP program for live animal production. Animal agriculture requested a more coordinated and participatory goal-setting research agenda, with USDA playing the role of facilitator and coordinator. The government role should be providing food safety oversight, sharing responsibility with a neutral third party, coordinating, research and facilitating model projects. HACCP concepts can be a part of voluntary quality

assurance programs, but critical control points do not presently exist for pathogens in live animal production. New partnerships must be built for pathogen reduction strategies. The Poultry Workshop representative presented a resolution that the United States Animal Health Association play a neutral, central coordination role for food safety long-term planning for research and education. All other workshop groups indicated a willingness to consider the resolution's merits.

A separate afternoon Research Funding Workshop suggested open competition, peer-review and new screening/evaluating processes for awarding government and non-governmental research grants to maximize high-quality, timely research. There was strong support for the formation of partnerships between industry, governmental agencies, academic institutions, foundations and consortia to accomplish needed food safety research. It was the view of this group that animal production food safety research will not be adequately funded under the current system of USDA agency research reviews.

On May 25, perspectives were presented from representatives of stakeholder groups along the farm to table continuum. The Consumer spokesperson described the animal production level as the roots of a tree and the consumers as the leaves. Interventions have the most profound effect at the root of the tree. Animals should be kept as clean as possible prior to slaughter and carcasses sanitized post-slaughter. Consumers are not the only critical control point.

The Large Packer representative stressed documenting good management practices, biosecurity and standard operating procedures for all levels of animal production. Quick and sensitive tests for pathogens are needed. Much is not known in the relationship of changing procedures on reducing pathogens in live animal production and the impact on reducing foodborne illness. Industry needs practical and economically feasible changes for HACCP programs.

Small Processors recognized the importance of animal and product identification and using it as a tool for pathogen reduction programs.

A representative of a Large Processing Plant noted that preharvest research should be spent on the identification of pathogens and production practices which prevent their spread. There is a need for rapid diagnostic tests.

The State Veterinarians' perspective stressed utilizing local state expertise; developing Memorandum of Understanding with States for animal production food safety programs; considering FDA's tissue residue program as a model for other preharvest activities in States; and utilizing State veterinarians for human food-borne illness trace-backs to animals and delivering preventive educational information to producers. Each State must be considered on a case-by-case basis for its ability to assist with preharvest foods safety programs. The United States Animal Health Association could provide a science-based, problem-solving, and consensus-building ongoing national forum.

A Livestock Marketing representative requested that all stakeholders refrain from establishing regulatory or programmatic barriers to any one sector's economic health. Market/dealers called for programs or controls that are science-based for all sectors of the industry.

A Feedlot Veterinary Practitioner stated that food animal programs should be industry-driven. Educational programs and training are key to addressing day-to-day management practices. The beef cattle quality assurance program is focused on human, not animal, health. In the past five years, the majority of feedlots have changed animal health practices based on food safety assurance. FSIS lacks commodity trust because it has always been regulatory in its approach.

The Swine Commodity representative requested more information about the ecology and epidemiology of significant human pathogens in animals before determining where intervention in the food chain is most appropriate. On-farm food safety programs will be possible for pathogens only if we focus on reducing or minimizing the risk of foodborne exposure, rather than on the elimination of the agent. It is important to use pilot projects to determine the effectiveness of model on-farm food safety programs and their cost/benefit. Incentives for producers would improve cooperation and collaboration. It is the responsibility of industry to develop, implement and maintain effective food safety assurance systems. Food safety must be built into the food production process, not inspected into it. Trace-backs to the farm should be used as an opportunity to learn, not to quarantine. Government must play a key role to help develop the research agenda and stimulate public investment in that agenda.

Egg Producers requested refrigeration regulations to be implemented quickly. The Egg Product Inspection Program is a successful food safety model. Continued research is needed on *Salmonella enteritidis*. Egg trace-back is unfair and unproductive. FSIS should support the United Egg Producers' Five Star Egg Quality Assurance Program as a universal program, provide technical assistance, verification and certification when requested, support certification of food handlers, and develop coordinated inter-governmental educational programs and media releases.

The Poultry Meat representatives stressed the need for research. The slaughter plant is the most feasible place now to focus pathogen reduction efforts. Food mishandling is a major component of food-borne illness. Certain principles of HACCP may apply to animal production. Actual critical control points in production do not exist as they do in a processing environment. Clean-out and disinfection, biosecurity, rodent control, and other procedures are program management areas, not critical control points. A non-exclusion pathogen strategy is applicable now. FSIS should consider using the term "food safety control points" as recommended in the AP-TAG Report.

A Research representative stressed that universities should be full partners in providing the science for improving food safety from farm to consumer. Open competition and critical review of research proposals is needed for all research.

A Dairy Producer requested funding pilot projects and demonstration farms to give new information to producers. We need to design Best Management Practices starting with processors and working back to the producers. Cooperation encourages innovation. Regulation stifles change. We need to build on the Quality Assurance Programs already in place. Producers can offer insight and help channel government efforts and need to be included as peers in program reviews.

A Beef Cattle commodity representative stated a need for research on why there is intermittent shedding of pathogens, how cattle transportation may contribute to the spread of pathogens, the effect of downer cattle on food safety, and standardized methods of sample collecting and culturing.

We need an industry-driven food safety clearing house to avoid research duplication. The beef industry stands ready to adopt and implement best management practices and technologies that research has shown will improve the safety of the nation's beef supply.

Mr. Taylor closed the forum by presenting a summary of the diverse perspectives presented. He felt there is a shared responsibility to address food safety at the animal production link in the farm-to-table continuum. Mandating HACCP or similar food safety practices on the farm is not currently feasible or likely to be productive. Animals carrying *E. coli* O157:H7 are not considered adulterated.

The private sector is willing to invest in research, develop partnerships to discover optimal opportunities for food safety assurance, and it has the practical knowledge to implement them. Producers must be fully involved in finding solutions. FSIS must ensure that research provides solutions for progress in food safety assurance, including those that may exist in animal production practices. Government's responsibility in animal production food safety is to facilitate focused research which will lead to the most productive and practical solutions to food safety problems. A process to focus public/private investment in prioritized food safety research is needed.

He pledged FSIS will play a leadership role to foster collaboration among the diverse groups working to address animal production food safety issues.

DEFINITIONS

"On-farm" refers only to live animal production on the farm. It does not include aspects of production included in animal production areas beyond the farm such as transportation, marketing, and feedlots or pre-slaughter practices.

"Animal production food safety" refers to all animal production practices from the farm to slaughter or for eggs transported to processing plants.

ACRONYMS

AAAP..American Association of Avian Pathologists
AABP...American Association of Bovine Practitioners
AHI...Animal Health Institute
AMI...American Meat Institute
APFS...Animal Production Food Safety
APFSP...Animal Production Food Safety Program (a Program within FSIS)
APHIS...Animal and Plant Health Inspection Service (an Agency of the USDA)
AP-TAG...Animal Production Technical Analysis Group
AVIC...Area Veterinarian in Charge
AVMA...American Veterinary Medical Association
ARS...Agricultural Research Service (the research arm of the USDA)
BPP...Best Production Practice
BQA...Beef Quality Assurance
CCP...Critical Control Point
CDC...Centers for Disease Control (and Prevention)
CSREES...Cooperative State Research, Education and Extension Service
CVM...Center for Veterinary Medicine (FDA)
DOT...Department of Transportation
E. coli...*Escherichia coli*
E. coli O157:H7...*Escherichia coli* O157:H7
EEC...European Economic Commission
EPA...Environmental Protection Agency
ERS...Economic Research Service (USDA)
FDA...Federal Drug Administration
FSIS...Food Safety Inspection Service (an Agency of the USDA)
GIPSA.....Grain Inspection, Packers & Stockyards Administration (USDA)
GFP...Good Food Practices
GMP...Good Management Practices
GPP...Good Production Practices
GVP...Good Veterinary Practices
HACCP...Hazard Analysis Critical Control Point
IQC...Integrated Quality Control (system)

LCI...Livestock Conservation Institute
MOU...Memorandum of Understanding
NCA...National Cattlemen's Association
NOAH...Network of Animal Health (AVMA—a computer-based, world-wide electronic network)
NPPC...National Pork Producers Council
NRI...National Research Initiative (USDA—a research funding mechanism)
NTF...National Poultry Federation
NVSL...National Veterinary Service Laboratories
PHS...Public Health Service
QA...Quality Assurance
QC...Quality Control
QAP...Quality Assurance Program
RFP...Request for Proposals
S.T.O.P....Safe Tables Our Priority
TAG...Technical Analysis Group
TB...Tuberculosis
TQM...Total Quality Management
VMO...Veterinary Medical Officer
UEA...United Egg Association
UEP...United Egg Processors
USAHA...U.S. Animal Health Institute
USDA...U.S. Department of Agriculture

DAY 1
May 23, 1995

Background Presentations

Mr. Michael Taylor
Administrator, Food Safety and Inspection Service and
Acting Under Secretary for Food Safety

ANIMAL PRODUCTION FOOD SAFETY: THE FSIS PERSPECTIVE

It's a pleasure to welcome you to this National Forum on Animal Production Food Safety. I want to thank all of you who are participating and working with us to find ways to improve the role of animal production in preventing foodborne illness.

I would like to take just a few minutes to talk with you about our overall strategy to improve the safety of meat and poultry products, the general approach we believe is appropriate to address food safety at the animal production stage, and what we hope to accomplish with this forum.

As you know, we have a clear-cut regulatory strategy for reducing hazards within meat and poultry plants, but we must take a different approach at the animal production stage.

This national forum—and the discussion we hope to have on such topics as research priorities and industry-based quality assurance and safety programs—reflect this different approach. It is one based not on direct regulatory controls but on devising effective, collaborative strategies to improve food safety.

FSIS FOOD SAFETY STRATEGY AND AGENDA FOR CHANGE

In the Federal Register of February 3, FSIS laid out for public comment and discussion a long-term science-based strategy to improve the safety of meat and poultry products and better protect public health from the farm to the table.

We said that our food safety goal is to reduce the risk of foodborne illness to the maximum extent possible and that we would do this by ensuring that appropriate and feasible measures are taken at each step in the food production process where hazards can enter and where procedures and techniques exist or can be developed to prevent the hazard or reduce the likelihood it will occur.

We believe that achievement of this goal requires fundamental transformation of the FSIS inspection program within meat and poultry plants. We need to rely less on command and control prescription of what happens in these plants and more on clear delineation of plant management's responsibility to install appropriate, preventive food safety procedures and achieve recognized food safety performance standards.

The HACCP (Hazard Analysis and Critical Control Points) and Pathogen Reduction regulatory proposals are a first step toward this fundamental transformation of our inspection program.

To make our in-plant HACCP initiative work and achieve our goal of addressing food safety hazards from farm-to-table, we must bring about change not only within FSIS-inspected plants but within FSIS as well.

HACCP and our greater reliance on food safety performance standards will change the relationship between our employees and the plants we regulate, from one centered on the policing of command and control requirements to one centered on holding companies accountable for meeting their food safety responsibilities.

HACCP and the farm-to-table food safety strategy will also change the work of our in-plant inspectors by requiring them to perform tasks they haven't performed before and requiring that we consider additional roles for

our employees outside of meat and poultry plants. For example, we are working with the Food and Drug Administration and the states to ensure that appropriate food safety standards are in place at the post-plant transportation, distribution, retail and food service stages of our food system, and we must determine what roles our Agency should play in seeing that these standards are met.

To be sure FSIS is prepared for its role in a HACCP-based farm-to-table food safety strategy, we are now reviewing all of our existing regulatory procedures and requirements to determine which ones need to be modified, streamlined or eliminated to be compatible with our new strategy.

We are also conducting an intensive top-to-bottom review of FSIS itself. We have brought together employees from throughout the Agency—headquarters and the field, frontline employees and senior managers, and representatives of our inspectors' union and employee organizations—to critically examine and recommend change in our Agency's regulatory roles, resource allocation and organizational structure. This review is intended to ensure that FSIS is making the best possible use of all of its resources to achieve the Agency's food safety and consumer protection goals.

We know that to achieve our food safety goals we have to be just as serious about change within FSIS as we are about change within the plants we regulate.

ANIMAL PRODUCTION FOOD SAFETY

Addressing food safety concerns at the animal production stage presents a very different challenge and requires a very different approach by FSIS.

We do not have and we do not seek the kind of direct regulatory relationship with animal producers that we have with packers and processors. It would be futile and unproductive to prescribe management practices at this level of the farm-to-table continuum. We also lack today the scientific knowledge that is needed to devise effective interventions at the production stage to reduce the risks posed by most foodborne pathogens.

Experience has shown, however, that preventive food safety strategies can be very effective at the animal production level. For example, industry quality assurance programs, coupled with regulatory oversight at the in-plant level, have kept the frequency of violative chemical residues relatively low.

We believe similar approaches have great potential to address the public health problem of microbial pathogens, but the scientific challenge is great. We need to determine scientifically the management practices and interventions that will be effective and practical to reduce the hazards posed by the most serious human microbial pathogens during the animal production, marketing, transportation, and pre-slaughter preparation stages. We can then use this information to encourage the development of commodity-specific quality assurance programs, similar to the preventive programs now in place to control chemical residues.

Some promising examples already exist of the role quality assurance programs can play to control pathogens at the farm level. For instance, we have made progress with animal production food safety in poultry and eggs, largely as a result of initiatives developed in response to the public health problem of *Salmonella* enteritidis (SE). A cooperative state, Federal, university, and industry pilot project is underway in Lancaster, Pennsylvania, to identify risk factors and risk reduction methods associated with SE in eggs. As a result, producers are voluntarily implementing food safety controls, such as rodent control, cleaning and disinfection, refrigeration of eggs, and testing of the environment.

In addition, under a cooperative project among FSIS, the Agricultural Research Service (ARS), the Animal and Plant Health Inspection Service (APHIS), and the National Pork Producers Council, intervention strategies are

being developed to control trichinae in pork. Our hope is that the trichinae project can serve as a model process for the certification of a pathogen-free herd.

It is clear that research will play an important role in our progress in the animal production food safety arena. We want to cooperate with researchers from government, academia, and industry to plan, conduct and evaluate food safety research. Coordination between the public and private sectors will allow us collectively to cover more ground and avoid duplication. Research dollars are scarce, and it will benefit no one to reinvent the wheel.

We also have a lot to learn from each other. Working together allows us to benefit from expertise that we may not have in our own organizations.

ANIMAL PRODUCTION FOOD SAFETY FORUM

And that brings me to our reason for being here today. We clearly need to collaborate with the producer community, academic scientists, and others in developing a focused research agenda. But we must go beyond that.

We must work together with all interested parties to craft strategies and practical action plans that will yield real progress on food safety. I know there is a commitment among those gathered here today to do everything it is reasonably possible to do to reduce food safety hazards at the animal production stage. But I also know that making good on this commitment will require collaboration among many parties, whose interests and expertise may vary, but who share an overriding stake in improving the safety of the food supply.

We at USDA want to work with you, and we seek your input on the role FSIS can best play in fostering progress on food safety at the animal production stage.

As you know, as part of last year's reorganization of USDA, the pre-harvest food safety program previously housed at APHIS has been moved to FSIS. We are fortunate to have Dr. Bonnie Buntain on board as director of the Animal Production (Preharvest) Food Safety Program. She and her staff are very committed to working with the scientific community, animal producers, consumer groups, and others interested in animal production food safety to find and implement measures to improve food safety from the farm to the slaughter plant. But, we seek your help, at this conference and beyond, in shaping the FSIS role and the FSIS program.

Finally, I want to thank all of you who helped plan this forum.

We appreciate the leadership the Food Animal Production Medicine Consortium has provided in the formulation of the program, as well as the participation of the U.S. Animal Health Association, the American Veterinary Medical Association, the Livestock Conservation Institute, the FDA's Center for Veterinary Medicine, the Centers for Disease Control and Prevention, the Association of State and Territorial Epidemiologists, consumer members of the Safe Food Coalition, industry coalitions, and others. It has truly been a joint effort to fine-tune the agenda and workshops to best achieve our common goals in animal production food safety.

BIOGRAPHY

Michael R. Taylor was named Acting Under Secretary for Food Safety on October 20, 1994, after that position was created by the USDA reorganization Act approved by Congress on October 5, 1994. He has served as administrator of USDA's Food Safety and Inspection Service since August 15, 1994, and continues in that capacity. As Acting Under Secretary for Food Safety, Taylor has responsibility for leading USDA's food safety activities.

Before joining USDA, Taylor served for three years as deputy commissioner for policy at the Food and Drug Administration, where he oversaw FDA's policy development activities and the processing of all FDA regulations. He was a partner in the Washington, D.C., law office of King & Spalding, specializing in food and drug law, from 1984 to 1991, after having been an associate in the firm from 1981 to 1984. He was executive assistant to the FDA commissioner from 1980-81, after having worked as an attorney in FDA's Office of the General Counsel from 1976-80. He served in the U.S. Army from 1971-73.

Taylor was a member of the editorial board of the Food Drug Cosmetic Law Journal from 1988-91. From 1985-87, he served as a member on the National Academy of Sciences' Committee on Scientific and Regulatory Issues Underlying Pesticide Use patterns and Agricultural Innovation. He has written and lectured extensively on legal and policy matters affecting food safety regulation.

Dr. Eugene J. Gangarosa
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AN ASSESSMENT OF HEALTH RISKS ASSOCIATED WITH CONTAMINATED ANIMAL PRODUCTS

INTRODUCTION

The purpose of this presentation is to give an assessment of health risks associated with foods of animal origin. This analysis is the culmination of many hours of discussion in our TAG group meetings and in meetings with colleagues at the Centers for Disease Control.

Three members of our animal production TAG committee worked on this report, Dr. Morris Potter, Dr. Phyllis Sparling, and myself. We also solicited opinions of eight national leaders in the field of foodborne diseases. We used a modified Delphi technique to solicit subjective opinions of these experts. All of them had strong ties to CDC, had made substantial contributions to the literature, and had made contributions to policy decisions on this subject. The information I shall share with you represents over two hundred years of cumulative experience of these eight experts and the three members of our health-impact subcommittee.

MATERIALS AND METHODS

We made our best effort to score the health impacts of foodborne pathogens associated with animal products. We did this in a way that provides a relative ranking of the importance of diseases caused by these agents. We hasten to acknowledge that we do not provide a quantitative report. We have not attempted to measure morbidity and mortality or the costs associated with these illnesses. We should note, at least parenthetically, that estimates of foodborne illnesses in the U.S. range between 6.5 to 81 million annually and that the economic impact to the U.S. economy is estimated between $8.5 and $20 billion in lost productivity each year. There is no way to estimate the global impact, but most agree that morbidity, mortality, and economic losses are greater, probably logarithmically greater, than in the U.S. Experts also agree that exported American products contribute to the problem. Clearly, we need to make our best efforts to get rid of the problem for safety and economic reasons.

Our analysis focuses on the twenty-five most common foodborne pathogens. We excluded other pathogens because of paucity of information and lack of experience in investigation and surveillance.

RESULTS

The first table shows our ranking of acute human health effects of the infectious agents transmitted by foods in the U.S. The scoring in this table was based on the severity of the acute health effects multiplied by the incidence. Two bacterial agents, *Salmonella* and *Campylobacter*, ranked first. In second place was *E. coli O157:H7*. *Toxoplasma gondii* ranked third.

Now let us look at the chronic health impact. What we considered in the category of chronic sequelae are miscarriages, birth defects, hemolytic uremic syndrome, chronic kidney disease, and arthritis. The second table shows our assessment of these chronic health effects. The rankings in this table were based on the severity of the chronic health effects multiplied by the incidence. As one might expect, the rankings change somewhat from the first table. Three agents ranked first, *Salmonella, Listeria Monocytogenes*, and *Toxoplasma gondii*; *E. coli O157:H7* was in second place, and in third place were *Taenia solium* and *Vibrio vulnificus*. In fifth place,

Yersinia enterocolitica was tied with *Trichinella spiralis*. Although smaller numbers of individuals are effected by the chronic conditions caused by these agents, affected persons suffer greatly. The burden on the health care system and, therefore, the economic impact, is undoubtedly greater.

This last table is a composite scoring; it conveys an overall assessment that takes into consideration both acute and chronic effects of the diseases caused by these agents. By multiplying acute impact by chronic impact, as we have done here, we dilute the rankings of agents causing disease with minimal chronic sequelae. This ranking shows *Salmonella* in first place, with greatest health impact, followed by *Campylobacter*, *Toxoplasma gondii*, *E. coli O157:H7* and *Listeria monocytogenes*.

DISCUSSION

How can this information help? These data may be useful in a number of ways. For example, the health-impact score showing that salmonellosis has the highest rank provides strong justification in proposing strategies for control based on a salmonellosis control model. Others may find it useful in rationalizing control strategies for disease/species-specific problems. For example, our scoring of *Toxoplasma gondii* may be helpful to the swine producing and marketing industries. These data may also serve as a baseline for future comparisons after control measures have been enacted.

Our method of analysis provides results notably similar to the ranking of foodborne diseases earmarked for priority control in the year 2000 health objectives for the nation, published in Healthy People 2000 Review ((DHHS pub. No. (Phs) 93-1232-1, 1992)). The food safety priorities in that publication include four of our top five pathogens, *Salmonella*, *Campylobacter*, *E. coli O157:H7*, and *Listeria monocytogenes*. *Toxoplasma gondii* is not included on the priority list perhaps because the population of immunosuppressed people, the group most severely affected by this infection, was not as large when the year 2000 health objectives were originally formulated in 1987. Nevertheless, the fact that the two lists are so similar enhances the credibility of our analysis.

Most of the agents in our health impact tables affect a variety of animal species, but some have host-specific characteristics. Infections caused by *E. coli O157:H7* most often derive from beef. However, the fact that poultry can be experimentally infected and experience long-term carriage may have implications for that and other animal-producing industries. Poultry features prominently as a source of *Campylobacteriosis*; *Toxoplasma gondii* and *Yersinia entrocolitica* can be transmitted from a variety of sources, but the fork is most prominent. Note that *Shigella*, which features prominently in foodborne outbreaks, has not been a problem for animal producing industries; this host specific organism for man is a post-marketing, food-handling problem derived from human sources. Similarly, *Bacillus cereus*, *Clostridium botulinum*, *Vibrio cholerae*, *Vibrio parahemolyticus*, *Vibrio vulnificus*, *Hepatitis A*, and the Norwalk viruses are not known problems for animal-producing industries. Cryptosporidiosis has a wide host-range, including poultry, cattle, and sheep, but food derived from these animals have not been known to cause human disease.

As an aside, we should note that early in this century, a disproportionately large share of foodborne outbreaks were caused by dairy products. Dairy products are now among the safest of our foods. Today, we are witnessing an analogous situation in which a disproportional share of foodborne diseases is caused by animal products. As we approach the problem of eliminating potentially harmful contamination in products of animal origin, we are at an historical crossroad that has an analogy to that period in our history, early in this century, when we finally came to grips with the problem of foodborne diseases caused by dairy products.

Similarities include:

1. A groundswell from the public for public health action to address the contamination problem arising from widespread national outbreaks.

2. The availability of new technologies that make it possible to address the problem. For control of contamination of dairy products, we had microbiological standards and pasteurization. For control of contamination of products of animal origin, the technologies that show promise are HACCP and irradiation. Although we looked at all aspects of animal production, an important focus of our TAG report deals with HACCP's potential to eliminate or reduce harmful pathogens from animal products. Dr. Peter Poss will comment later today on the limitations of HACCP in live animal production because contamination can occur at a myriad of points during production and, once infected, animals tend to remain infected. For this reason, reduction of contamination by a HACCP strategy is achievable, but elimination is unlikely. Our TAG team did not address the question of irradiation because it is not an animal-production issue. However, irradiation of products prior to marketing was recognized as a technology of great potential benefit. We must recognize that HACCP alone is not likely to eliminate harmful contamination of meat and poultry products just as the microbiological standards imposed on dairy products early in this century did not eliminate the risks of those products. Dairy products became safe by the combination of microbiological standards and pasteurization. It will require an analogous combination of both HACCP and irradiation to ensure that meat and poultry products will be as safe as dairy products.

3. What seems clear from the literature is that concerns about irradiation, both in the scientific community and in the lay press, are strikingly similar to the concerns noted in the national dialogue leading to the decision to pasteurize dairy products.

Tables follow in Appendix B.

SUMMARY

I have given you a qualitative assessment of the health impact of the 25 most common foodborne pathogens associated with animal products. This assessment is a comparative ranking based on data available in the literature and the experiences of eight experts in this field. We have determined that the pathogens with the greatest health impact are *Salmonella*, *Campylobacter*, *Toxoplasma gondii*, *E.Coli O157:H7*, and *Listeria monocytogenes* in that order. I have called to your attention the fact that the health objectives for the year 2000 have a similar ranking except that *t. gondii* was not included. The fact that the two lists of leading pathogens are so similar lends credence to our analysis. Our report notes several ways these data may be useful. We have detailed species-relevant information. We have noted that foods of animal origin, while not the exclusive purveyors of foodborne diseases, are more often associated with these diseases as compared to foods of other origin. The data presented here suggest that even though most foodborne diseases could be controlled by careful attention to food handling practices in the kitchen, they are not. This is a rationale for risk reductions at every possible point from farm to table. However, because HACCP has limitations, irradiation is probably going to be necessary to make meat and poultry products as safe as dairy products.

BIOGRAPHY

Dr. Gangarosa received his medical degree and Masters Degree in Microbiology from the University of Rochester, Rochester, New York. He completed speciality training in Internal Medicine at Walter Reed Army Medical Center in Washington, DC. He received training in Public Health and Epidemiology at Walter Reed and in the Epidemic Intelligence Service at the Centers for Disease Control in Atlanta, Georgia. He served at CDC for 15 years, initially as chief of Epidemic Intelligence Service and subsequently as chief of Enteric Disease Activities. He started the Foodborne Disease Surveillance Activity in 1965. He has contributed over a hundred publications on subjects dealing with all aspects of food and waterborne diseases. After he retired from the U.S. Public Health Service in 1978 he became Dean of the Faculty of Health Science and the School of Public Health at the American University of Beirut, a position he held until November, 1981. From 1982 to 1991, he directed Emory's Master of Public Health Program, which was accredited as a School of Public Health in 1992. He has a

long affiliation as consultant to International Health Agencies, including the World Health Organization and the World Bank. He served as a member of the International Committee for the Microbiological Specifications for Foods and continues to serve on WHO's Expert Committee on Enteric Diseases. He currently serves as Professor Emeritus at Emory University and teaches a course on Food and Waterborne Disease. He is also a consultant in the private practice of Public Health, offering services in Food and Waterborne Diseases and disease prevention.

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PERSPECTIVES ON FARM TO TABLE FOOD SAFETY CONTROL POINTS

What I'd like to give is an overview of farm-to-table. Some of the critical points in a farm-to-table food safety policy will perhaps generate a little discussion later about how some of these control points might or might not be effective in reducing risk.

The topic is Perspectives on Farm to Table Food Safety Control Points. Obviously, some of the impetus for this is the new proposed regulations on pathogen reduction and HACCP systems, commonly known as the "mega-reg" within the food industry. There are some very good points in the "mega-reg" and some things that are worthy of further discussion, but we'll use it as kind of a backdrop for the talk this morning on farm-to-table critical control points. There are three basic approaches to controlling food-borne pathogens in meats or in foods of animal origin, and these include reduction in the live animal, during processing, and pathogen reduction processing.

The proposed regulations for animal production include improving food safety at the animal production stage. This is obviously incorrect. FSIS' authority does not extend to animal production, and the quote directly out of the "mega-reg" is "there may also be a link between on-farm control measures and mandatory implementation of HACCP". Here they're referring to HACCP in the slaughter plants. Again, the idea is that HACCP will become a mandatory part of food safety inspection.

When we talk about production sources for foods of animal origin, we're obviously including beef cattle, swine, poultry, eggs and dairy products. Farm-to-table production of meats includes the animal production, animal storage of feeds, the actual slaughter inspection, processing into food for human consumption, and the consumers who contribute to the contamination of the process or the product.

A couple of the control points are the production source of the animal or animal product, transportation of the animal or animal product to the processing area, and a critical area which very often is overlooked—the distribution, retail sale and preparation of these products by the consumer.

If we are truly going to have a farm-to-table food safety program, all of the aspects of the farm-to-consumer's table must be included. We have four areas that I'd like to address in animal production; that is, the diseased animals, carrier animals, the feed or foodstuffs of the animals, and the environment in which the animals are produced.

The veterinary medical profession does an excellent job of dealing with diseased animals. Everyone associated with the field of veterinary medicine can be very proud of their roles in dealing with diseased animals.

The area that we probably have a poor understanding of is the role of carrier animals; that is, animals that are carrying potential pathogens, especially human pathogens, and yet show no clinical symptoms or signs of illness. We need to do more research in this area to understand how to control some of these pathogens. The role of foodstuffs and the production environment are important since most of these pathogens survive very well in an animal production environment as well as in the animal itself.

Dr. Hancock of Washington State was kind enough to provide me with some information that he has put together, listing six different pre-harvest interventions for pathogens or food-borne pathogens. These include trace-back to

the herd or flock level, inspection of animal production sites, testing of animals pre-slaughter, vaccines, pre-slaughter treatments, and ecological methods, which is primarily animal management.

There are a couple of examples of trace-back to herd or flock level that are currently in food production or production of animal origin products. One of these is the *Salmonella* Enteritidis Program. If there is a human outbreak related to eggs, there is an attempt to trace the product back to the flock level, testing both the environmental samples and, if those are positive, testing organ samples from the birds themselves. If it is determined that there is a positive source for SE, then the eggs are diverted to a breaker plant; that is, they're not sold as fresh raw eggs anymore. They're actually sold for further processing, and again the emphasis here in the SE Program is a diversion of the product. We're not destroying flocks unnecessarily nor eliminating the problem on the farm. It's simply a matter of diverting a product from normal raw sale into a further process sale. If there is an example of a meat product that can be determined to have a higher incidence of *Salmonella*, then those animals could possibly be designated for further processing, such as canned products.

Another example of trace-back to the herd level involves *Salmonella*, and this is being practiced right now in the Danish swine production system. In Denmark, they're using a serological testing method, something that is referred to as a "mix-ELISA", for the detection of *Salmonella* antibodies in the serum. They're not testing for the organism per se, they are testing the animal serum for the presence of *Salmonella* antibodies, which would indicate that the animal has been exposed to *Salmonella* at some point. They are not saying that a positive serological response necessarily means that the animal is positive for *Salmonella.* They're simply saying that a positive response indicates that the animal may have been exposed to *Salmonella.* It's done on a herd level, not on an individual animal level. Herds with relatively high titers of *Salmonella* antibodies are examined in detail. They go back to the production sources and examine the environment, the management practices, and make attempts to lower that level of serum antibody titer.

If they have herds of animals with very high *Salmonella* antibody titers, they are slaughtered separately from the animals or the herds that have lower antibody titers, and currently they have a three-class system regarding the levels, the herd levels of antibody titers, and are using that in a rough way to sort product by relative level of exposure to *Salmonella.*

They also recognize that they have few, if any, *Salmonella*-free herds of swine, that virtually every herd has the presence of *Salmonella* in it. What they're trying to do is to use this as a management tool to see what can be done to improve the quality of the animal coming into the slaughter plant. Again they're not destroying product or animals. They're simply using a ranking system to in effect keep the animals with the higher level of risk, that is, a higher antibody titer, separate from those which have a lower antibody titer.

There is interest in this mix-ELISA and what applications it has within the United States. I believe within the next year or so this test will be used in some experimental purposes at least within the United States to see if it does have an application here. One organism I feel I have to mention here is Escherichia *E. coli O157:H7.* Again, my information comes from Dale Hancock at Washington State, who studied E.coli in cattle extensively. His conclusions to date are basically that *E. coli O157:H7* exists intermittently in a majority of cattle farms; that is, they have found it at one point or another in a majority of the farms that they have examined. But what they have also found is that on an individual animal basis, it appears to be a very transient member of the gastrointestinal tract; that is, there is not the presence of chronic carriers in cattle. They seem to have the organism at some point and then clear it from their gastrointestinal tract. An animal that may be positive one month will be negative several months after that. So, at this point it seems to be a very transient member of the micro-flora.

The present interpretation of the data is that because of this high level of incidence, and the fact that the organism is a transient member of the micro-flora, they don't feel that trace-back to a herd level necessarily would be an effective control, because of the fact that it occurs very widely, and the fact that it does not seem to establish a

shedding pattern within individual animals. So, sorting by herds in their interpretation doesn't seem to be a very effective means of controlling the organism.

It has been proposed that there would be some form of inspection at the actual production site for animals. If this is considered a viable option and consensus of opinion is that we should go this way, then the goals for this inspection should be very clearly established as well as what the basis for inspection is.

There is a very wide diversity in animal production sites around the country, from the very small producers to what we in Iowa now refer to as the corporate farmers, who have some very large vertically integrated processing systems. Because of this diversity, we need to consider very closely exactly what it is that we're looking for, if we intend to inspect animal production sites. Dr. Pierson will talk after me on HACCP systems on quality control systems, in animal production sites, but what I'm saying here is that if we do decide to do inspections at the production site level, we need to have some ground rules because we need to know what we're looking for. And the answer right now, as far as the research on some of these food-borne pathogens is, we may not know the factors that influence, for example, the presence of E.coli in cattle. We may not know all the factors that influence the presence of *Salmonella* in poultry. If we're looking at inspection of production sites as a means of control, then we need to think very carefully about what it is we're looking for and exactly what it is that we're trying to accomplish.

The testing of animals pre-slaughter has also been proposed as a food safety control point. This is again herd-based testing. Several people have remarked on the use of the Danish system for swine as a model system for testing animals again at the herd level with the intent of developing some kind of a ranking or scoring system and a possible diversion of product. This may or may not be feasible, again because of the diversity of production sites. For swine production, I know that the Danish system is going to be tried on an experimental basis in the United States within the next several years.

Herd-based testing would probably be based on the presence of antibodies, and again that would be antibodies to the organism. That would not necessarily be the presence of micro-organisms in the animal itself. That would simply indicate the level of exposure, and again it would come down to the interpretation of those results and the actual intent for the use of the results.

Given the modern production systems for animals and animal products in the United States, withholding animals from slaughter needs to be very carefully considered, given the production schedules and the disposition of the animals. If an animal is withheld from slaughter, what do you do with it? That is an area that we would have to discuss as far as what we would use these herd-based results for. Vaccines have been proposed as a means of controlling food-borne pathogens in the live animal. There is some data that shows that vaccines can be effectively used against invasive pathogens; for example, *Salmonella.* But the word of warning here on these vaccines is that we know what the vaccines do as far as clinical illness, and they do in fact prevent clinical illness. We do not fully understand what they do in terms of the carrier state of those organisms. For example, if an animal has been vaccinated with an attenuated *Salmonella* for control of clinical Salmonellosis, does that still mean it cannot become or it cannot acquire *Salmonella* and it cannot shed *Salmonella*? Unfortunately, vaccines, at least in the very short-term, don't seem to offer much promise for non-invasive pathogens, specifically things like *E.coli*, which are in fact transient members of the gastro-intestinal tract. A vaccine doesn't hold out a lot of hope for that, at least not in the short-term.

PRE-SLAUGHTER TREATMENTS

Currently, antemortem inspection is part of the normal food safety inspection. There's been some discussion on modification of the GI tract micro-flora, and this goes along with the feed withdrawal proposal. There's some

information that would suggest that animals can be treated or processed somehow to modify this intestinal flora immediately prior to slaughter, either by feed withdrawal or by adding something to the feed. Hide decontamination is being done on an experimental basis; that is, removing the contamination, the mud and manure, from the outside of the animal prior to slaughter, although the current data hasn't conclusively shown that does anything as far as controlling contamination on the carcasses themselves.

Ecological methods are mainly animal production methods. There has been a great deal of research done in poultry on competitive exclusion; that is, feeding healthy or normal members on bacteria of the intestinal micro-flora to poultry with the idea of reducing or eliminating the pathogens from the GI tract of the animal. There have been some very good successes with competitive exclusion in poultry. USDA, ARS in Athens has been very successful in their work with competitive exclusion. This may well be a technology that will be available to us in the near future. Management practices will be discussed with isolated weaning of swine later in the day. This is a herd management practice that seems to potentially reduce the incidence of not only animal pathogens but possibly human pathogens as well. Feed contamination has been addressed fairly widely so far. Obviously, if we could eliminate the *Salmonella* from the feed, that would eliminate a critical source of *Salmonella* entry into the live animal.

Processing, good manufacturing practices, sanitation, HACCP, anti-microbial treatment and microbiological testing are all included in the proposed regulations which are currently out for comment right now. Irradiation is a very effective means of eliminating bacteria. The exact applications to an animal product and the consumer issues with irradiation may be separate issues, but strictly from a microbiologist's standpoint, irradiation kills E.coli. Irradiation kills *Salmonella.* It kills *Listeria*, and the food safety implications are very good. Again, consumer issues may be a separate issue with food irradiation.

Retail sale may be a weak link in our processing, and in our distribution of our foods. Retail locations are inspected by local health officials. Some of the areas that need to be re-emphasized at retail sale are sanitation and temperature control. If we're going to talk about pre-harvest strategies or animal production strategies to reduce contamination at the retail level, cross-contamination or co-mingling of product goes on fairly regularly. So, if there is a system to sort levels of *Salmonella* exposure to rank meat or quality of meats by microbiological testing, then we have to be aware that at the retail level those products may be co-mingled and, if that happens, then all of the benefits of animal production food safety probably get lost at the retail level.

If we are truly going to talk about farm-to-table, we need to include the table in our discussion, and that includes the consumer. We need to put some additional efforts into consumer education. Obviously, we don't expect all of our consumers to have a B.S. in microbiology, but they should be aware of some of the basic food-handling practices. These include, for example, temperature control and sanitation. We already recognize that pathogens, such as *E. coli O157:H7*, can be eliminated by proper cooking. We could make some very significant impacts in that organism if we could simply convince people that they don't want to eat their hamburgers medium rare. So, there are some areas for consumer education at this point. Also, we need to examine some of the consumers' perceptions of the risk involved with food safety. Long-range, it would be nice if nobody ever got sick from food again. In the short-term, we need to make people aware of what some of these risks are and some of the things they can do to reduce their own personal risk because, ultimately, it's the consumer that decides whether or not they're going to eat a specific food, and again this goes back to consumer education. If we could convince our consumers that medium rare hamburgers are not the best thing microbiologically, we could probably make an impact on some of these food-borne diseases.

BIOGRAPHY

Dr. Dickson received his Ph.D. in Food Science and Technology from the University Nebraska, Lincoln, in 1984, his M.S. in Dairy Science-Manufacturing from the University of Georgia in 1980, and his B.S. in Microbiology from Clemson University in 1977. He is currently the Associate Professor, Department of Microbiology, Immunology and Preventive Medicine, at Iowa State University. Previous professional positions include Research Food Technologist and Lead Scientist, U.S. Department of Agriculture, Agricultural Research Service; Microbiologist, Tony's Pizza Service; and Manager, Food Irradiation Applications, Radiation Technology, Inc.

Dr. Dickson's professional affiliations include the American Academy of Microbiology, American Society for Microbiology, Institute of Food Technologists, and International Association of Milk, Food and Environmental Sanitarians, Inc. In 1994 Dr. Dickson was elected as a Fellow in the American Academy of Microbiology and received 3 Certificates of Merit from USDA for outstanding research performance. He has published more than 45 referred articles in scientific journals, and has presented 17 abstracts at national and international meetings.

Dr. Merle Pierson
Virginia Polytechnic Institute and State University

APPLICATION OF HAZARD ANALYSIS CRITICAL CONTROL POINTS (HACCP) TO ANIMAL PRODUCTION FOOD SAFETY

On February 3, 1995, USDA/FSIS proposed for all FSIS inspected meat and poultry establishments requirements "that are designed to reduce the occurrence and numbers of pathogenic microorganisms in meat and poultry products and to reduce the incidence of food borne illness associated with the consumption of those products." An important part of the proposed rule is the requirement for all meat and poultry establishments to develop, adopt and implement HACCP. Note that the requirements for HACCP involves all federally inspected meat and poultry establishments not just raw beef and poultry products. Although HACCP has already been adopted by many food processors, including meat and poultry operations, the adoption by all processors is a major, sweeping change for the industry and regulatory.

HACCP started in 1959 with the Pillsbury Company's manufacture of food products for the NASA space program. There was concern about the safety of the foods that were consumed as well as other safety concerns related to foods. System failure due to food particles contaminating electrical circuitry was one potential problem. This was solved by using bite size food pieces that were specially coated and individually packaged. A requirement was that foods consumed on the spacecraft has an absolute assurance of safety. One consideration for this assurance of safety was attribute sampling for pathogenic microorganisms. However, this was discarded when it was recognized that the presence of 1 *Salmonella* organism in 1000 units of food could result in a 98% probability of accepting a defective lot if 20 units were sampled, and a 50% risk of 690 units were sampled. The required level of testing for assurance of safety was impractical and ineffective. The Zero Defects Concept was also considered and discarded because reliable non-destructive testing methods for bacterial pathogens were lacking. The U.S. Army's "Modes of Failure" concept to predict what could go wrong and to select key points in the process to monitor (the forerunner of modern process control) was evaluated and adopted. From this evolved the concepts of Critical Control Points and prevention, thereby laying the foundation for the development of the HACCP system.

In 1971, at the United States Conference on Food Protection, the principles of HACCP and their application to foods were first described. There were 3 principles—identification and assessment of hazards associated from growing to consumption; determination of the critical control points to control any identified hazards; and, establishment of systems to monitor the critical control points. This platform has since been modified and extended to the format now published by the National Advisory Committee on Microbiological Criteria for Foods (NACMCF) and Codex Alimentarius.

In 1972 there was an outbreak of botulism from commercially canned potato soup. This outbreak prompted the U.S. Food and Drug Administration (FDA) to promulgate regulations for the production of low acid canned foods. These regulations had many of the basic concepts found in HACCP. Also, in 1972, FDA inspectors were trained in HACCP principles and their application. During the 70's, however, there was much talk at scientific meetings and only a few American food processors embraced the HACCP discipline. While it was seen as an exciting initiative, the extensive work involved in correctly implementing the requirements often cold not be justified and the interest in HACCP stagnated.

In 1985, the United States National Academy of Sciences rekindled major interest through the publication of their report "Microbiological Criteria for Foods and Food Ingredients" which strongly endorsed the use of HACCP as an effective, preventive system for the safe manufacture of food products. The International commission for the Microbiological Specifications for Food (ICMSF) followed in 1988 with their fourth volume which covers HACCP in food safety and quality. This publication should be recognized for its contribution towards the

internationalization of HACCP. In 1989, the NACMCF published their recommendations titled "HACCP Principles for Food Production." The NACMCF is appointed by and advises the USDA, DHSS, FDA, DoC, NMFS, and DoD. In 1991, the Codex Committee on Food Hygiene developed "Guidelines for the Application of the Hazard Analysis and Critical Control Point (HACCP) System." This Codex report was adopted by the 20th Session of the Joint FAO/WHO Codex Alimentarius Commission in 1993, and is currently at Step 8 for adoption. As a result of experience in applying the HACCP principles and recognizing the changes proposed by Codex, the NACMCF revised their recommendations and published them in the document "Hazard Analysis and Critical Control Point System." The NACMCF is currrently revising their 1992 document. The Committee's goal is to provide a concise document that clearly defines the HACCP principles, and fives practical guidance in their application.

Should sole responsibility for food safety rest with the food processor? No, I don't believe so. The proposed rule by USDA/FSIS states that "There is wide agreement that ensuring food safety requires taking steps throughout the continuum of production, slaughter, processing, distribution, and sale of livestock and poultry carcasses and meat and poultry products to prevent hazards and reduce the risk of food-borne illness." The NACMCF stated in their 1992 document on the hazard analysis critical control point system that "The committee again indorses HACCP as an effective and rational means of assuring food safety from harvest to consumption." Why consider the entire food system? Over 90 to 95% of the food borne disease outbreaks in the U.S. are brought to be attributable to mishandling of food at the food service level and at the home.. Responsibility for food safety occurs at every stage of the food system. The goal should be for animal producers to produce animals that carry a low probability of being a source of food borne hazards for consumers. Likewise, food processors must prevent food borne hazards as well as distributors, retail and food service. Finally, consumers have a responsibility to properly prepare and handle foods. In addition, there is a legislative and regulatory responsibility in food safety.

The USDA/FSIS proposed rule has a section titled "Improving Food Safety at the Animal Production Stage." It is stated that "the voluntary application of HACCP principles can be useful in establishing the CCPs within the farm management and live animal transportation arenas where pathogenic organisms can enter the food chain." The preamble goes on to list several producer quality assurance programs that cover topics such as animal health and residue avoidance. I understand that many of these quality assurance programs have similar preventive concepts like those found in HACCP. Likewise, the food industry has several quality assurance programs.

HACCP is not the magic bullet that absolutely solves all food safety problems. It is, when properly applied, a set of preliminary steps and principles that gives a systematic method for identifying significant hazards and properly applying preventive measures so that food-borne hazards are prevented, eliminated or reduced to an acceptable level. With international and national agreement on HACCP principles and their application we have commonality of understanding of the development, implementation and maintenance of a food safety system. Having these commonly understood principles, many food processors, for example, require their suppliers to have a HACCP system for production of ingredients that hey supply. Knowing that a source of food borne hazards can be from the live animal there will be more attention given to live animal production for implementation of effective, documented systems that eliminate or reduce the likely occurrence of food borne hazards. Application of HACCP offers widely understood principles for identifying significant risks and their control.

Can HACCP be applied to animal production for preventing, eliminating, or reducing to an acceptable level food borne hazards of significant risk? I don't think there is a simple yes or no to this question. I encourage the adoption of HACCP in animal production and give a word of caution to not create another set of principles or terminology for food safety. Setting the politics and concern about regulation aside, let's look at where HACCP might be applied and how the HACCP principles and concepts could be used. For HACCP to be implemented there must be hazards of significant risk for which preventive measures are known and the HACCP principles properly applied.

HACCP is defined as a systematic approach to be used in food production as a means to assure food safety. Many groups have encouraged the application of these principles to every stage of the food system. The HACCP concept is to prevent food safety problems before they occur. These food safety problems include biological, chemical, and physical hazards.

The development of a AHCCP Plan and a AHCCP system involves the application of five preliminary steps and seven principles. There are:

1. Assemble the HACCP team.
2. Describe the food and the method of its distribution.
3. Identify the intended use and consumers of the food.
4. Develop a flow diagram which describes the process.
5. Verify the flow diagram.
6. Principle No. 1. Conduct a hazard analysis. Prepare a list of steps in the process where significant hazards occur and describe the preventive measures.
7. Principle No. 2. Identify the CCPs in the process.
8. Principle No. 3. Establish critical limits for preventive measures associated with each identified CCP.
9. Principle No. 4. Establish CCP monitoring requirements.
10. Principle No. 5. Establish corrective action to be taken when monitoring indicates that there is a deviation from an established critical limit.
11. Principle No. 6. Establish effective record-keeping procedures that document the HACCP system.
12. Principle No. 7. Establish procedures for verification that the HACCP system is working correctly.

The written document that is developed from the application of these steps so the production of a food product is the HACCP Plan. The next step is to implement the plan with the result being a HACCP system. Finally, the HACCP system must be maintained through periodic verification and updating.

A big mistake that is often made in relation to HACCP is to assume that it covers only pathogenic bacteria. In applying HACCP, all food borne hazards are to be considered. During this conference you will be discussing hazards associated with animal production. There are a number of hazards that can originate during animal production. Some examples of food borne hazards that can originate during animal production include: Biological - *Salmonella, Campylobacter jejuni, E. Coli* O157:H7, *Listeria monocytogenes*, *Yersinia enterocolitica*, *Cryptosporidium parvum, Trichinella*; Chemicals - pesticides, animal drugs; Physical - needles, shot. An important definition in HACCP is the one for Critical control Point (CCP): a point, step or procedure at which control can be applied and a food safety hazard can be prevented eliminated, or reduced to an acceptable level. Therefore, if the identified food safety hazards are to be controlled through a HACCP system, there must be a step or steps in production where control can be applied and there must be an associated preventive measure. It is essential that there be scientifically documented steps and preventive measures. If this criterion cannot be met, then a HACCP system cannot be developed. A HACCP system can only be developed through proper application of the preliminary steps and principles of HACCP. As essential prerequisite to HACCP is the adoption of Good Manufacturing Practices (GMPs). Similar programs are absolutely essential in animal production; they must be a prerequisite to applying HACCP to animal production. To date, most of the animal and feed production HACCP Plans I have seen are essentially GMP plans in a HACCP format. The biggest problem in these HACCP Plans is the lack of true CCPs.

I previously mentioned the various quality assurance programs in animal production and that they addressed chemical hazards as well as physical hazards. I see the most immediate application of HACCP would be in the

control of physical and chemical hazards. Many of the quality assurance programs have principles similar to HACCP. The use of HACCP would offer a harmonization of the various programs both on a national and international basis.

An example of an animal production operation that considers chemical hazards is the HACCP Food Safety Program developed by Coleman Natural Meats Inc. My comments are not meant as a critique, agreement of disagreement with their program, rather I wish to illustrate HACCP application related to chemical hazards. Coleman's HACCP plan covers animal production, slaughter, processing and shipping. They also have sections on retail quality control and end consumer use. Animal production includes the ranch, live animal shipping, feedlot, shipping to slaughter, and receiving. Coleman Natural Meats considers growth promotants, antibiotics, pesticides and herbicides as the hazards. The critical limit for these chemicals is non detected at any stage of production: ranch - feed, water, animal; shipping - animal; feedlot - feed, water, and animal; and slaughter receiving - animal. Note that only chemical hazards are addressed in the Coleman Natural Meat animal production section of their HACCP Plan.

For animal production, biological hazards is a much more difficult issue to deal with than for most of food processing. For example, we know that proper heating times and temperatures for cooking hamburger will kill E. Coli O157:H7; therefore, this can be a CCP. Also, there are interventions during animal slaughter and processing that can reduce the level and incidence of pathogens. However, what about interventions at the animal production level? At present there is not enough known about the sources and control of *E. Coli* O157:H7 to be able to apply preventive measures during animal production. There are many promising production interventions for controlling *Salmonella* and *Campylobacter* in poultry; however, there is still much to be done to effectively apply this technology to production so that control of the pathogens is assured. Does the technology exist in animal production so that CCPs can be identified, control of pathogens can be applied and a significant hazard(s) be prevented, eliminated or reduced to an acceptable level?

Sweden is often referenced for its programs on Salmonella control in poultry. For example, an article was published in the January 1995 issue of Prepared Foods that had the headline "*Salmonella*-free guarantee." According to the article, the country's largest poultry producer, Kronfagel, guarantees that every package of raw or cooked chicken is *Salmonella*-free. In addition, every package has on it the name and address of the producer. The article describes several production interventions for what is claimed to be *Salmonella*-free (SF) birds. The five principles that are used for the production of SF poultry are: 1. Day old chicks must be SF. The breeding flock is raised in quarantine and only if SF can they be used for hatching the parent generation. Eggs are coded and if *Salmonella* is found at a later stage, the parent source can be identified and destroyed. 2. Feed and water must be SF. No antibodies can be used in feed. 3. The hatchery and production environment must be SF. 4. The entire production chain is checked regularly and if *Salmonella* is found, the source is determined. 5. Immediate corrective action is taken if *Salmonella* is found. The article did not discuss *Campylobacter* or other possible pathogens. The system that is described does have some similarity to the HACCP concept and there appears to be a desired reduction in the incidence in *Salmonella*.

Several interventions at the animal production stage have been proposed for the control of food borne pathogens. For example, there has been considerable progress in possible Salmonella and Campylobacter reduction during broiler production; however, the research has not provided the certain reduction or elimination of these pathogens. Some possible interventions during animal production include: animal trace back, replacement progeny, vaccination, environment control, diet, feed/water, competitive exclusion and handling during transport. These are all possible interventions that could be considered as preventive measures on which a CCPs could be based. However, these interventions need considerable research before they could be applied on a practical basis in a HACCP system for actual animal production. Hopefully, these and other interventions can at some time be applied in a practical way for the control of food borne pathogens.

Last year I led a workshop on HACCP and hog production. My conclusion form that experience and the possible interventions I have seen for other meats and poultry is that there are few situations where one could write and implement a HACCP plan for the control of pathogens at the animal production level. One example where preventive measures for a human pathogen can be effectively implemented is the control of Trichinella spiralis. Recall the definition of CCP that I gave you earlier. In the absence of known preventive measures for identified hazards, a HACCP plan cannot be developed and implemented Is there an immediate use for HACCP and the control of pathogens during animal food production? YES. When I was leading the hog production workshop, I found that during the hazard analysis sessions these was need to add a topic that I usually don't include in HACCP workshops. The topic was research issues. I believe that the HACCP concepts can be used to evaluate animal production systems and determine significant hazards and where interventions might best be established. Such an application of HACCP would be a very useful tool in evaluating risks and identifying production interventions for effective and practical pathogen reduction or prevention. Keep in mind also that if HACCP is to be implemented in animal production there must be effective prerequisite programs in place such as good production practices.

BIOGRAPHY

Dr. Pierson joined the Virginia Polytechnic Institute and State University in 1970 and served from 1985 to 1994 as head of the Food Science Department. He is a Fellow of the Institute of Food Technologists and the american Association for the advancement of Science. Dr. Pierson has been active in research on food borne pathogens such as *Clostridium botulinum*, *Listeria monocytogenes*, *Salmonella*, *E. coli* O157:H7, *Yersinia*, and many others.

He has published over 100 journal aricles and five books on food quality and safety. His book HACCP: Principles and Applications is wiely used for HACCP training. Dr. Pierson is a member of the National Advisory Committee on Microbiological Criteria for Foods and serve as chairman of the HACCP Subcommittee. In addition Dr. Pierson teaches several HACCP workshops each year and assists companies in developing and implementing HACCP.

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MEAT INSPECTION SHOULD BE A GUARANTEE FOR A SAFE AND WHOLESOME PRODUCT; A CHALLENGE FOR THE FUTURE

Meat inspection, as it is performed today, has not been changed for the last eighty years and is based on the detection of sick animals:

In last decades big changes have taken place in husbandry and in slaughterhouses such as:

1. Feedlots
2. Increase of the use of veterinary drugs
3. Environmental contaminants
4. Slaughter lines with high speed
5. Decreasing amount of animals with pathological lesions
6. Contamination during processing
7. Symptomless carriers of zoonotic agents.

All these changes have not been followed by an adaptation of the meat-inspection performance and that leads to more and more doubt about the fact if the meat inspection still guarantees the safety and wholesomeness of meat. The reality of the protection level can be demonstrated on the basis of the amount of gastro-enteritis in the Dutch population. Population studies show that there is an incidence of 300,000 million cases in the population a year. Half of this amount is possibly caused by food; 150,000 million cases a year. These figures make it clear that another approach to protect the consumer must be chosen.

In my opinion the new approach should be based on a short-term and long-term strategy and of course interaction between.

1. SHORT-TERM STRATEGY

A. MEAT-INSPECTION

In the EEC there is the possibility of an alternative meat-inspection system (article 17 Directive 641433/EC). Some countries (i.e. UK, The Netherlands, Denmark, and Germany) have offered eight proposals to the Commission to modernize the meat-inspection performance for pigs which is now under discussion in the Scientific Veterinary Committee.

The main conditions of the proposal are:

1. Integrated Quality Control (IQC) System
2. Good Veterinary Practice (GVP)
3. Feedback of results of meat inspection to the farmer
4. Adequate identification and registration system
5. Health logbook for treatments and transactions
6. Preselecting of abnormalities by the farmer
7. Farmer guarantees that the pigs are healthy with no visible anatomical abnormalities
8. The system is on a voluntary basis
9. Herd must comply with a "meat-inspection" index
10. Separation between the pigs produced under the conditions of this system and the other pigs

11. The system should be operation during one year in practice to the satisfaction of the competent authority

In the Netherlands, most of the conditions are already fulfilled; there already exists an IQC system which integrates GVP, health logbook, and a feed-back system to the farmer. Furthermore, all links of the chain must have in the future their own GMP-code.

At the moment in the feed industry, a GMP code is already applied. In three months, a GMP code for slaughterhouses will be applied. All these codes have microbiological parameters to check the achieved level of GMP. The system is controlled by the slaughterhouses and by an external audit system to assure that the rules will be applied at an appropriate way. The problem of eradication of zoonoses is not yet a major item of this system, but the GMP codes for *Salmonella* which have been developed will hopefully be one of the conditions of the IQC-system in the Netherlands for pigs as soon as possible..

The total amount of pigs in the Netherlands that already share the system is about 3 million pigs (20%). It is expected that this amount will grow very fast because at the retail level there is a growing demand for QC-system produced meat. The major advance of this IQC-system is a frame-work which can be used for application of new developments.

B. ZOONOSIS-ERADICATION

In the EEC, an attempt has been made to achieve a fundamental approach of zoonosis (Directive 92/117/EEC). In this directive, a start has been made with a fundamental approach of *Salmonella enteritidis* and *S.typhimurium* in breeding flocks and humans. If the presence is noticed, measures must be taken like destroying eggs and flocks. Furthermore, a surveillance must be carried out in humans.

In the Netherlands, this system is integrated in the IQC-system which exists for poultry. Therefore, cleaning and disinfection of pens is also an integrated part of the eradication measures of Salmonellosis.

Although this is only dealing with a part of the zoonotic problem, it is an encouraging attempt to attack the problem on the basic which means on the farm.

LONG-TERM STRATEGY

Although the above-mentioned developments are a first step in the right direction, it is necessary that in the future there will be a more flexible system of meat inspection.

At the moment, all these systems are not based on epidemical figures in man. Furthermore, there is no separation in performance between countries or regions although the threats for the consumer can be totally different. Therefore, it is necessary to base a new meat-inspection system on risk-analysis.

The main elements of risk-analysis are:

1. Risk-assessment
2. Risk-management
3. Risk-policy

RISK ASSESSMENT

Risk-assessment is the primary scientific process and is regarded as the estimation of the likelihood (probability) and severity (magnitude) of harm or damage resulting from exposure to the hazardous agents or situations.

This definition is based on the scientific work in relation to chemical hazards. Therefore, the model cannot be used in relation to biological threats without:

a. Hazard identification. All hazards which can be detected during post-mortem inspection should be taken into account.
b. Hazard characterization. All hazards should be considered and the priority could be based on the severity. This can vary from country to country or even regions.
c. Exposure characterization. For zoonotic hazards, the way of handling the meat after retail is very important for the exposure to the hazard because of the fact that bacteria multiply in "good" conditions. That is not the case with chemical hazards. Therefore, the model should be based on the worst-case exposure.
d. Risk-characterization. All differences between non-detection rates of a procedure for all identified hazards together with a scientific assessment of the consequence of each difference should be considered.

It is clear that risk-assessment models depend on extensive field trials in the animal and human population. In particular, it is very important that the amount of samples is related to the frequency with which the hazard occurs in the population. This is also a limitation because, if the assurance of non-detection is too high, these field trials will not be practical. The accepted level of non-detection is a political decision.

RISK MANAGEMENT

It is necessary that the funds available will be used as effectively as possible. Therefore, it is absolutely necessary that the health status of the farm is known so that the meat inspection can be concentrated on the real problems.

The government has to start a discussion with the consumer to make clear that "zero-risk" cannot be achieved. This makes it necessary that the public be fully aware about what is done by government and also what the industry does to minimize the hazard. The regulators, from their side, must follow a consistent regulatory policy.

CONCLUSIONS AND RECOMMENDATIONS

It is clear that meat inspection should be changed as soon as possible to achieve a better protection of the consumer. The member State proposal for article 17 of directive 6414331EEC and the zoonosis directive 92/l 1 7/EEC have been tried at least to get a link between the farm and the meat-inspection (post-mortem inspection). Furthermore, with the new approach, which is now under discussion, article 17 key-words like IQC GVP HACCP and identification/registration are more or less obligations to take part in the new system.

In relation to the zoonoses directive, it is hopeful that the principle has been introduced to eradicate a zoonoses at the source. True, at the moment this approach is limited to *Salmonella enteritidis* and *Salmonella typhimurium* in breeding flocks, but it is a good step forward. The obligation for active surveillance in humans is also a new element in the field.

However, if we want to achieve a real breakthrough, a new consumer-protection system should be based on the principle of risk analysis. This principle, which already is accepted for chemical hazards, could also be used in a modified way for biological hazards. Unfortunately, this way of thinking is not yet accepted in the field of consumer protection.

Nevertheless, this is the only way to build a flexible protection system, including meat inspection, which takes into account the real hazards for the public in relation to the consumption of meat. With this approach, we should

base our system on scientific hazards and not on trade hazards. At the end of this process we should also be honest and admit to the public that with all legislation and the most sophisticated way of producing and processing meat, a "zero risk" will never be achieved.

The government has a moral obligation to take the most appropriate measures to assure the public that the produced meat is safe and wholesome and to make transparent to the public how the system works and also what "safe" means.

It is also clear that the industry has its own responsibility concerning the protection of the consumer. New systems like IQC, HACCP, GVP, etc. should be installed not only for quality reasons but also to achieve a safe and wholesome product. Therefore, it is necessary that items like eradication of zoonosis and slaughter hygiene are integrated elements of such a system (a stable to table approach). Only then can those systems contribute to the consumer protection.

The producers should communicate to the consumer which measures they take to minimize the risks because the more transparent a system is for the public the more people will rely upon it.

The ultimate goal should be meat that is controlled from "stable to table".

BIOGRAPHY

Dr. Jos Goebbels received his degree in Veterinary Medicine in 1981 and began his career as a veterinarian in the Meat-Inspection Service of the Netherlands. Currently, Dr. Goebbels is employed by the Ministry of Health, Netherlands, as Deputy Chief Veterinary Officer, Department of Meat-Inspection, veterinary drugs and rending (including import control). He is a member of the Standard Veterinary Committee, Regulatory Committee of Veterinary Drugs, EEC Steering Committee for Modernization of the Meat-Inspection and member of the Dutch working group for Modernization of the Meat-Inspection System and coordinator for public health problems concerning food of animal origin.

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FOOD-BORNE DISEASE: CONTROL OF *Salmonella* CONTAMINATION IN FOODS OF ANIMAL ORIGIN

THE ORGANISM

The *Salmonella* genus of bacteria, named for the late USDA veterinarian Daniel E. Salmon, was identified over 100 years ago. More than 2,100 specific antigenic types have been characterized and new types are still being identified. Except for the Arizona group, until 1966 most motile *Salmonella* were designated with a serotype name corresponding to the geographic site of initial isolation, such as S. st. paul. Serotypes after that date have been designated by antigenic formulae. [1]

Bacteria of the genus *Salmonella* are gram-negative rod shaped organisms, meaning that when exposed to the Gram staining process, they are decolorized and do not retain the blue color of gentian violet stain. Individual *Salmonella* are serotyped on the basis of chemicals called antigens associated with the bacteria surface (O antigens) and flagella (H antigens). They are grouped according to O antigens (Group A, B, etc.) and individually identified by their H antigens. Although 2,100 have been identified, only a few account for the majority of infection and disease in animals and humans. They share many cultural and antigenic properties with other members of the family Enterobacteriaceae.

Of the myriad of properties which can be cited as characteristic of the *Salmonella* genus of bacteria, two capabilities tower above all others in relation to control and prevention strategies in animal populations. First, most *Salmonella* serotypes have a wide host range, being able to infect essentially all warm and cold-blooded animals, including humans. Second, *Salmonella* organisms have the ability to survive for long periods of time outside the host animal under the right environmental conditions. Because of these two capabilities, most *Salmonella* serotypes are truly ubiquitous, "being everywhere at the same time", throughout the world. This is the daunting challenge of *Salmonella* control, the realization that only by well-planned, enormous effort can this ubiquitousness be interrupted. It is these two capabilities that bring us together today and which represent the major obstacle to the control of these organisms.

THE INFECTION

Animal Infection. Many species of *Salmonella* cause disease in all animals and are characterized clinically by one or more of the major forms of the disease. These are septicemia, or widespread infection throughout the body, and acute and chronic enteritis or intestinal infection. [2] The very young animal is especially susceptible to infection, although animals of any age can be infected.

Older animals often show no signs of disease. In most cases, the organism gains entrance to the body through ingestion with resultant inapparent to severe infection. *Salmonella* contamination of animal feed and environmental surroundings is a common source of infection. Hatching egg associated transmission occurs in poultry. Animals can remain shedders of the organism in the feces for long periods following clinical recovery or

inapparent infection. A few species, such as S. cholerasuis in swine and S. Pullorum in poultry, are particularly adapted to specific animal hosts, but the majority of *salmonella* causing infection in animals are non-host adapted.

A total of 36,073 *Salmonella* isolates from animal disease cases and epidemiological related sources in the U.S. were reported in 1992 to 93. Of these, 98% were serotyped by the USDA National Veterinary Services Laboratory. This was an increase from 31,284 in 1991/92. Two hundred ninety-two serotypes were identified. Approximately one third of all isolates submitted for serotyping resulted from activities of the Pennsylvania Pilot Project and the S. enteritidis (SE) control program. The 10 most common serotypes accounted for 53% of the isolates and in descending rank were S. enteritidis, typhimurium, heidelberg, hadar, cholerasuis, agona, montevideo, kentucky, reading, and seftenburg. [4]

Human Infection. Similar to animals, a few *Salmonella* species, such as S. typhi, are particularly adapted to humans. The majority of infections in humans in the U.S., however, are related to *Salmonella* serotypes that cause infections in animals and humans. Most infection in humans is initiated by ingestion of the organism with resultant inapparent to severe infection. Contaminated foods of animal origin are common sources of infection. Clinically, infection is often characterized by gastroenteritis, or an infection of the stomach and intestine. Other forms are enteric fever or septicemia, bacteremia and focal infections in the body. Individuals can remain carriers and shedders of the organism for long periods. Infants, the elderly and individuals who are malnourished or have underlying health problems, are especially susceptible to infection. [3]

The total number of *Salmonella* isolates reported from human sources in the U.S. in 1992 was 34,520. Isolations in 1991 were 40,012. The 10 most frequently reported *Salmonella* serotypes from human and nonhuman sources reported to the Centers for Disease Control are described in Table 1. The 10 most common serotypes in humans accounted for 62% of all reported serotypes. [5]

FOODS OF ANIMAL ORIGIN IN THE U.S. DIET

Figure #l shows the annual U.S. per capita consumption (retail weight) of various foods for the period 1984-1993. [8] Over this period, there has been a trend of increased consumption of vegetables (fresh and canned), flour and cereal products, and poultry meats, while consumption of fruit (fresh and canned) and fish & shellfish is currently about the same level as 1984. Consumption during this period has decreased for beverage milks, red meats and eggs. About 35% of the energy, 67% of the protein, 35% of the iron, 75% of the calcium and virtually all of the vitamin B12 come from animals and animal products, as do other essential nutrients. [9] Foods of animal origin remain a major component of the U.S. diet.

FOOD ANIMAL HEALTH VERSUS PUBLIC HEALTH CONCERNS

Although *Salmonella* infection in food animals remains a serious disease threat, particularly in the young animal, modern husbandry and preventive veterinary medical and therapeutic practices have effectively limited the severity of the clinical disease and associated economic loss to the point that clinical salmonellosis is not viewed in the U.S. as an industry-disruptive animal disease. On the other hand, it is not uncommon for animal populations to be exposed and infected with *Salmonella* sometime in their lifetime. Animals in populations so exposed shed the organism, resulting in contamination of their preharvest environment and other live animals in that environment. Foods of animal origin produced in that environment can also be contaminated. In the case of meat animals, preharvest live animal infection and contamination at the farm level is a major cause of subsequent contamination of the animal environment in transport vehicles at time of harvest and contamination of the environment of the animal, carcass or meat product during slaughter and processing. Preharvest *Salmonella*

infection and contamination of live food animals is a major cause of *Salmonella* contamination of raw foods of animal origin in the human food chain.

While animal health concern related to salmonellosis in food animals has decreased due to improved management and medical practices, public health concern related to clinical food-borne illness in humans caused by *Salmonella* has increased. It is estimated there are 3,000,000 annual cases of human food-borne *Salmonella* infection in the U.S.A. The USDA Food Safety Inspection Service (FSIS) states that most raw foods of animal origin are assumed to be contaminated with *Salmonella* and are major vehicles for *Salmonella* contamination of human foods. Other sources of *Salmonella* include pets, rodents, turtles and wild animals. [7]

RECENT REACTION TO FOOD-BORNE DISEASE AND PERCEIVED RISK

As an example of the increased public health concern about food-borne microbial disease associated with foods of animal origin, an article in the February 9, 1993 edition of the "Wall Street Journal" reported that a food service corporation, which owns and operates 720 of 1,151 domestic restaurants of one fast food chain, stated they had experienced a 30-35% drop in sales in a two week period following the week of January 18, 1993 during which an outbreak of a bacterial infection linked to contaminated hamburger meat was first widely reported. The article reported that one child had died and 425 people had become ill, mostly in Washington state, after eating hamburgers prepared by the fast food chain which were contaminated with E. coli bacteria and then cooked under federal regulations at 140 degrees Fahrenheit, 15 degrees below a more stringent Washington state regulation.

This serious, focal outbreak of food-borne microbial disease caused by *E. coli O157:H7* was met by a nationwide flurry of media activity; widespread concern by citizens both directly and indirectly involved as consumers; increased activity of so-called consumer organizations, including a reported lawsuit against USDA to require warning labels on meat; advisories by various state and federal public health agencies; congressional hearings; statements by the U.S. Secretary of Agriculture that the nation's meat inspection program must be improved to detect and eliminate dangerous microbial contaminants and that several methods, including new tests and irradiation, should be considered; a revision of Standard & Poor's Corp. outlook on the corporation involved to "negative" from "stable" because of the food-borne illness; the food service corporation involved was reported to have changed its public-relations counsel because of a difference in strategic direction; and finally, the President of the United States addressed the problem during a nation-wide Town Hall meeting on February 10, 1993. All the above occurred by February 13, 1993, a period of approximately 3 weeks.

Observing the reaction, in 1993, to this focal *E. coli O157:H7* food-borne disease outbreak, I was again impressed with the modern day communication media's ability to quickly inform the nation of such an incident and how quickly we, as consumers, react in our own self interest by avoiding purchase of a perceived risky food. In the U.S., we have the option, because our market-place economy provides us with an incredibly diverse, bountiful and safe food supply, to simply reject one source of food in favor of another. This reaction, in turn, sends to food industries and corporations involved instantaneous, clear and harsh market-place signals (lost market share, reduced credit rating, etc.) that such perceived risk is unacceptable. These market signals also indicate there are economic rewards if perceived risk can be avoided. Our market-oriented economy is a self correcting mechanism. In this case, private companies in the food chain will automatically strengthen quality assurance measures to avoid identified real and perceived food safety risks to consumers in order to maintain and increase market share. The public sector system establishes additional regulations and surveillance on behalf of consumers.

Finally, I got the overall impression from some of what I heard, saw or read in the media about this incident that this was a new danger and needed new solutions. The reality is that *E. coli O157:H7* was first associated with

food-borne disease in 1982 in an outbreak also associated with undercooked hamburger meat. It is but one of several microbial organisms, including *Salmonella*, that can be associated with raw foods of animal origin which if not destroyed before consumption, by proper cooking for example, can result in illness or death. Nothing really new here except, perhaps, a growing dichotomy. On the one hand there seems to be a growing societal assumption that all of the food available to individual or corporate buyers for preparation and/or consumption is or should be absolutely safe. On the other hand, the reality is that, in terms of raw foods of animal origin, microbial contamination problems, including *Salmonella*, remain, in my opinion, as prevalent today as in 1982 and before.

While the above example involves *E. coli*, food-borne illness due to *Salmonella* remains of paramount public concern. The reasons for concern and strategies for control are similar for both types of organisms. In many ways, they are stand-ins for one another.

NEW DIRECTIONS AND REGULATIONS WILL BRING CHANGE

Three relatively recent landmark events have occurred in the U.S. which have set into motion forces of change in the human food chain which will inevitably lessen this dichotomy by bringing about an absolute reduction, if not elimination, of undesirable microbial contamination, such as *Salmonella*, in raw foods of animal origin. The first of these was the 1985 National Research Council (NRC) of the National Academy of Science report " Meat and Poultry Inspection: The Scientific Basis of the Nation's Program." [10] The second was the 1990 Food and Drug Administration (FDA) Center of Veterinary Medicine's (CVM) announced goal of *Salmonella*-free animal feed and feed ingredients for the U.S.A. The third is the 1995 USDA-FSIS proposed rule "Pathogen Reduction: Hazard Analysis and Critical Control Point (HACCP) Systems." [12]

The NRC report stated "It is well established that species of *Salmonella* and *Camplyobacter* are major causes of diseases transmissible to humans through the consumption of meat and poultry products, and the committee concluded that current postmortem inspection methods are not adequate to detect these organisms." The report concludes that the most effective way to minimize public health hazards associated with infectious agents (such as *Salmonella*) in meat and poultry is to control these agents during the production phase on the farm and to incorporate a Hazard Analysis Critical Control Points (HACCP) inspection approach from production of farm animals, slaughter, processing, handling at retail outlets, food service establishments and in the home.

The CVM goal of *Salmonella* negative feed is the direct result of the agency's responsibility for the regulatory options for controlling microbiological contamination of animal feed and the fact that animal feed is regulated under the Federal Food, Drug and Cosmetic Act's definition of "food." Under regulation, FDA regards animal feed ingredients or blended mixtures of these encountered in interstate commerce and found upon examination to be contaminated with *Salmonella* or other pathogenic organisms as adulterated. CVM has chosen to initially concentrate on developing and implementing HACCP plans for all segments of the feed industry as the means to achieve *Salmonella* negative feed. CVM considers feed to be adulterated if a sample of the product contains even one *Salmonella* organism.

The FSIS proposed rule is a direct descendent of the NRC report and establishes requirements for FSIS inspected meat and poultry establishments that are designed to reduce the occurrence and number of pathogenic microorganisms in meat and poultry products and to reduce the incidence of foodborne illness associated with consumption of these products.

A fourth event is the 1995 report of the USDA-FSIS/APHIS Animal Production Technical Analysis Group (AP-TAG) which will be discussed at this meeting. The AP-TAG was formed as part of the FSIS Track II process to study the live animal production (preharvest) phase of meat and poultry production in relation to the control of microorganisms, chemicals and physical agents associated with foodborne illness. This AP-TAG report is also a direct descendent of the 1985 NRC report.

The above four events have enormous ramifications from the point of view of currently accepted animal production and animal health practices. The major goal of all four is to improve public health by reduction of zoonotic pathogens, such as *Salmonella*, borne by raw foods of animal origin. Most of these pathogens, such as *Salmonella*, are bacterial and can infect all animal populations, including food animals, but may cause little clinical disease or economic loss to the food animal industry. The objective, the NRC, FDA, FSIS and AP-TAG recommendations is to eliminate zoonotic agents, such as *Salmonella*, from live food animal populations in order to reduce contamination of raw foods of animal origin.

This is a new era of animal disease control programs. It is the era of control of noneconomically disruptive zoonotic disease agents in food animal populations for public health rather than animal health reasons. That is, food animal industries will be required to control infective agents, such as *Salmonella*, that are of marginal economic importance from the point of view of production efficiency, because they are of significant public health importance. A control program to reduce or eliminate *Salmonella* contamination of farm animals will be staggering in scope and complexity which, at the same time, must be economically compatible with the efficient production of farm animals.

THE FOOD CHAIN

The author described a model of the food chain in California, a state with the largest population (30 million citizens) and the largest agricultural output ($18 billion) in the U.S. The model food chain included only in-state activities and included both plant and animal foods. The chain was divided into segments with the estimated number of firms, establishments or events in each segment. The segments were likened to "locations" along a one-way freeway. The segments were as follows: Preharvest Production (81,000 farms); Harvest & Processing and Further Processing (13,000 firms); Distribution (25,000 firms); Final Meal Preparation (85,000 establishments plus 10,381,000 households); Consumption (33 billion meals per year). [13]

Each of these "locations" represents a distinct segment of the food chain which has a distinctive function in food availability. Many separate industries and tens of thousands of firms and establishments as well as millions of households work within the chain and are effectively coordinated by the private sector market place. This remarkable food chain system provides us with a plentiful supply of high quality food at minimum cost and is a key factor in our economy's ability to create wealth.

INTEGRATED *Salmonella* CONTROL THROUGHOUT THE FOOD CHAIN

Effective prevention of *Salmonella* food-borne disease in the U.S. requires an understanding that *Salmonella* contamination can be introduced into foods at any point or "location" along the food chain freeway. Like a freeway, there are "on-ramps" by which *Salmonella* can gain access to foods within firms, establishments or households in each of the segments of the food chain. This is an extremely complex system made up of hundreds of thousands of firms, establishments and millions of households on a national basis, that stun one's senses when considering programs to prevent *Salmonella* contamination.

As the NRC recommendations point out, effective prevention clearly requires simultaneous, integrated implementation of controls within and throughout each segment of the food chain from Preharvest Production to Consumption. A systematic method of applying such control is the concept of HACCP. It is a systematic and straightforward way of thinking and is aimed at process control. The objective is to identify hazards that contribute to introduction of *Salmonella* in each segment, firm, establishment and activity in the food chain. The goal is to analyze how to effectively block access of *Salmonella* to every "on-ramp" and to put into place critical control points that control the specific food production, manufacturing or handling process in each firm, establishment and household in such a way as to prevent contamination.

An integrated HACCP program, involving the entire food chain from Preharvest Production through Consumption, provides a systematic way to prevent food-borne disease caused by *Salmonella* and is based on risk avoidance as well as risk minimization. Education, directed at all segments of the food chain, is an important component of such a program.

SPECIAL EMPHASIS ON ANIMAL (PREHARVEST) PRODUCTION

The NRC report calling for HACCP programs beginning on the farm, the FDA goal of *Salmonella* negative animal feeds for food animals and the AP-TAG report place special emphasis on the development and implementation of procedures that will reduce or eliminate *Salmonella* infection or contamination from live food animals during Animal (Preharvest) Production. It is clear that reduction or elimination of *Salmonella* contamination in live animals will significantly reduce contamination in raw foods of animal origin. This will be a national goal even if improved risk minimization procedures, such as irradiation following processing and continually improved food handling procedures during final meal preparation, are implemented as they should be. In my opinion, irradiation of raw foods of animal origin, as well as other "pasteurization" processes, must be considered as an essential component of any farm-to-table HACCP program in a manner similar to the Grade A, Pasteurized Milk model.

The objective of such a goal is to reduce or eliminate live animal associated *Salmonella* contamination of slaughter and processing plants, thereby drastically reducing or eliminating *Salmonella* contamination of raw foods of animal origin. The challenge for the food animal industries and associated industries is to devise HACCP programs that will accomplish this goal in a manner that is industry-compatible and noneconomically disruptive rather than economically disruptive to the involved industries.

The scope of an Animal (Preharvest) Production goal to implement HACCP programs to reduce or eliminate *Salmonella* in live food animals at the farm level in the U.S. is staggering. Table #2 describes the U.S. livestock and poultry populations in 1992 and estimates that approximately 7.2 billion animals are at risk to *Salmonella* infection or contamination in a given year. From the standpoint of population at risk, such an Animal (Preharvest) Production *Salmonella* control program, will be the largest single animal health program ever undertaken in the history of the world. From the standpoint of controlling or eliminating an organism that has the capability to infect all cold and warm blooded animals and can remain alive for long periods of time outside the host, such a Preharvest Production *Salmonella* control program will be the most technically difficult animal health program ever undertaken. We are essentially discussing the largest, most difficult and most expensive Preharvest Production animal health program ever. A Preharvest Production *Salmonella* control program aimed at reduction or elimination will be orders of magnitude larger than the tuberculosis and brucellosis control programs in food animals. It is truly a new era of animal health. There are two basic strategies for a program to reduce or eliminate *Salmonella* from live food animals during Preharvest Production. The first is an exclusion strategy in which procedures are developed to exclude *Salmonella* organisms from gaining access to the live food animals. The goal here is to avoid risk. The second is a non-exclusion strategy in which it is assumed *Salmonella* will gain access to live food animals and procedures are developed that will limit the effect or extent of infection. The goal is to minimize risk.

EXCLUSION STRATEGY OF CONTROL (AVOIDANCE OF RISK)

Exclusion is a program based on the premise that live food animal populations can be raised *Salmonella* free at the farm level under commercially compatible conditions and that exposed populations will be eliminated. It is based entirely on developing and implementing procedures that will prevent *Salmonella* organisms from gaining access to *Salmonella* negative animals on the farm. Its goal is to reduce the number of infected populations to zero. Exclusion relies on sanitary engineering, sanitation, security, surveillance procedures and depopulation of infected populations. These same procedures will effectively control many other infectious disease agents. The

FDA goal of *Salmonella*-negative animal feed for food animals and the AP-TAG report recommendations have HACCP program goals which would greatly benefit an exclusion strategy. As one can surmise, an exclusion strategy must be perfect in its implementation because any introduction of *Salmonella* into a population will result in rapid infection and contamination of the entire population. If the goal is *Salmonella* negative animals, infection is not tolerated. Sweden implemented a *Salmonella* control program in 1961 and both red and white meat produced in Sweden can today be claimed to be *Salmonella* free. The annual broiler production in Sweden is approximately 40 million chickens, with an average flock size of 20,000.15 The stated objective and strategies for the control of *Salmonella* in Sweden especially in poultry but also in other foodproducing animals is as follows: to insure that all animal products delivered for human consumption are free of *Salmonella.*
Strategy :

- Prevent *Salmonella* contamination of the food chain.
- Monitor at all critical points of the production chain to ensure that no *Salmonella* contamination occurs.
- Motivate producers economically to participate in the program.
- Create a legal framework to ensure cooperation and compliance to the program.

Sanitary engineering and sanitation play a critical role in an exclusion program. The use of effective disinfectants and sanitizers is extremely important for both physical surface sanitation, but also for such uses as animal feed and water sanitation. There is a great need for more research and development in the sanitary engineering area and the identification of new disinfectant and sanitizer products for use at the farm level and throughout the food chain.

NON EXCLUSION STRATEGY OF CONTROL (MINIMIZATION OF RISK)

Non exclusion is a program based on the premise that live food animal populations cannot be consistently raised *Salmonella* free at the farm level under commercially compatible conditions and that exposed populations will not be eliminated. It is based primarily on developing and implementing procedures that will reduce clinical *Salmonella* disease in infected animals; reduce the number of *Salmonella* infected animals in an exposed population; and reduce the number of *Salmonella* organisms in an infected animal. Non Exclusion relies on sanitary engineering, sanitation, security and surveillance as well as the use of artificial stimulated active immunity (vaccination), therapy (drugs), and novel biological control procedures such as those aimed at preventing *Salmonella* from colonizing in the intestine. USDA's Food Safety Inspection Service is engaged in a systematic investigation of *Salmonella* control in broilers at the farm and processing plant. [16]

Novel biological control procedures are being researched and hold promise to be an important resource in the *Salmonella* control and prevention field. These procedures include manipulation of the micro flora of the intestine by natural means to prevent colonization of *Salmonella.* For example, oral inoculation of animals with non-pathogenic, natural enteric microbial cultures which when established in the intestine compete and exclude *Salmonella* (competitive exclusion) is a field of great interest as is the role of lactic acid bacteria in a similar role. Competitive exclusion is utilized in Sweden's *Salmonella* control program on farms which experience *Salmonella* outbreaks and is being investigated in the U.S.A.

WHICH STRATEGY WILL THE NATION RELY ON?

The nation will, I believe, inevitably rely on the exclusion strategy in order to achieve a goal of Animal (Preharvest) Production of *Salmonella* free food animals. Until there is consensus that *Salmonella* free Animal (Preharvest) Production is achievable, we will follow a hybrid program initially emphasizing non exclusion with increasing emphasis on developing and incorporating the necessary sanitary engineering, sanitation, security and surveillance procedures to eventually achieve exclusion of *Salmonella.* The author and coauthors have described a model program for elimination of *Salmonella* contamination of turkey meat. [18]

The adaption of the Grade A, Pasteurized Milk model for the control of microbial agents in raw foods of animal origin and, in this context, the incorporation of irradiation and other "pasteurization" processes where possible, will be an essential part of the farm-to-table HACCP concept. Opposition to the use of irradiation for this purpose, represents, in the author's opinion, antisocial behavior of a most egregious nature.

NATIONAL FORUM FOR ANIMAL PRODUCTION FOOD SAFETY NEEDED

Development and implementation of industry compatible, noneconomically disruptive, live animal production HACCP programs that effectively reduce microbial contamination of raw foods of animal origin will require an ongoing national forum where food animal and allied industries, state and federal agencies, and the scientific community can come together on a regular basis for discussion, planning and evaluation purposes. The United States Animal Health Association can most effectively serve the nation as the necessary national forum on Animal Production Food Safety.

TABLE 1

The 10 most frequently reported *salmonella* serotypes from human sources in 19925 and nonhuman sources in 1992/934 the U.S.

Human sources		Nonhuman sources	
Rank	Serotype	Rank	Serotype
	typhimurium *	1	enteritidis
2	enteritidis	2	typhimurium *
3	heidelberg	3	heidelberg
4	newport	4	hadar
5	hadar	5	choleaesuis **
6	agona	6	agona
7	infantis	7	montevideo
8	montevideo	8	kentucky
9	thompson	9	reading
10	oranienburg	10	seftenberg

* includes var. copenhagen ** includes var. kunzendorf

TABLE 2

Livestock & Poultry Populations in the U.S. - 1992

Cattle & calves* (Milk cows = 9,844,000)	100,892,000
Swine*	59,815,000
Sheep*	10,191,000
Egg type chickens*	357,107,000
Broiler chickens**	6,388,990,000
Turkeys**	288,980
Total food animal population	7,205,975,000

"Agricultural Statistics 1993" USDA
* number animals on hand 12/1/92 or 1/193
** annual production 1992

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BIOGRAPHY

Dr. McCapes is a fourth generation veterinarian, his family providing veterinary services since the 1870's. He has concentrated in the area of population medicine, including safety of foods of animal origin and poultry medical practice. He lives in Davis, California.

He currently serves as Third Vice President of the United States Animal Health Association, is a member of the U.S. Department of Agriculture Food Safety Inspection Service's Track II Animal Production Technical Analysis Group and the U.S. Department of Agriculture Secretary's Advisory Committee on Foreign Animal & Poultry Diseases. He is Chair of the Food Safety and Diseases of Public Health Significance Committee of the American Association of Avian Pathologists.

He served as member and Chair of the Veterinary Medicine Advisory Committee to the U.S. Food and Drug Administration in 1988-92. In 1994, he received the Food and Drug Administration's Commissioner's Special Citation Award from FDA Commissioner Donald Kessler at an awards ceremony in Maryland. The citation reads: "For outstanding contributions as a clinician, teacher, researcher, administrator, and advisor on *Salmonella* in feed, public health, and avian veterinary medicine."

His poultry industry career included employment by Ralston Purina Company's primary turkey breeding operations in California and part ownership of Nicholas Turkey Breeding Farms, Inc., a primary breeder of turkeys based in California, until it was sold in 1979. He is an emeritus faculty member of the School of Veterinary Medicine, University of California, Davis.

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OVERVIEW-ANIMAL PRODUCTION TECHNICAL ANALYSIS GROUP REPORTS (AP-TAG)

Note: The AP-TAG Report is a "living" document. The process of review is just starting.

The Animal Production Technical Analysis Group (AP-TAG) was empaneled by the United States Department of Agriculture (FSIS and APHIS) to provide an assessment of human food safety hazards, risks and controls in the production of red meat and poultry. **Thus, this report focuses on public health through good management practices in the production of food animals.**

The report is divided into ruminant (including equine), pork, poultry and risk assessment sections. The AP-TAG examined phases of the livestock production cycle to identify foodborne hazards and recommend controls of those hazards or scientific needs to establish appropriate controls. **The AP-TAG emphasized Hazard Analysis Critical Control Points (HACCP) as a significant component of pre-harvest food safety processes.** In this regard, pre-harvest food safety was considered to be those procedures that reduce the prevalence of foodborne pathogens and contaminants that enter our food chain up through delivery to the slaughter facility.

There was general agreement that production and regulatory practices over the years have reduced hazards in red meat and poultry that are considered as pathological (animal disease lesions), chemical (residues) and physical (glass, needles, metals, etc.). **However, these hazards have been superseded by microbiological hazards.** Industry, academia, and government have made great strides in detecting microbial agents and documenting their effects on human health. Some of these microbes are not animal pathogens, but are now recognized as emerging threats to human health and productivity.

The production of livestock for food is a dynamic process as new products and procedures evolve to meet market demands. It is essential that all food animal producing industries establish standards for quality of production and food safety. These standards must be periodically evaluated to improve public health and product quality. **Because of the complexity of the red meat and poultry food chain, a functional food safety system must encompass the farm-to-fork concept within a framework of shared responsibility from producer to consumer.**

RECOMMENDATIONS

1. A risk-based approach that will be effective in assuring the safety of foods of animal origin should be adopted. This approach should be acceptable to industry and the consumer and be scientifically rational.

2. Food safety and quality assurance programs must embody new approaches to hazard reduction of human health risks. These should follow HACCP procedures for identifying, monitoring and controlling risks to human health. Perhaps an acronym different from HACCP such as "food safety control points" (FSCP) could be employed.

3. Specific hazard control points in the production systems must be identified. Breeding stock, production facilities, feeds and ingredients transportation, and animal-to-animal contact (including humans and other vectors) are identified as strategic food safety control points. Rules for sanitation and prevention of contamination will need further consideration. This will occur as their level of importance in overall food safety and quality is defined by needed research.

4. Emphasis should be on a farm-to-table approach to food safety, total quality management and/or quality assurance programs. **Effective food safety and quality assurance programs must be established by each industry. Government programs and efforts must focus on monitoring food safety and maintaining public health.**

5. There is a continuing need for ante-mortem inspection and for joint industry and government programs to promote quality assurance such as exists now in residue control. Memorandums of Understanding (MOUs) between government and industry should be a basis for cooperation to achieve food safety.

6. Emphasis must be placed on surveillance and control programs for selected organisms not yet identified as being risks to human health. As different pathogens emerge and are identified as hazards to human health, such as *E. coli* O157:H7, program surveillance must refocus on these new pathogens. Presently, *Salmonella, Campylobacter, Toxoplasma gondii, E. coli 0157:H7*, and *Listeria monocytogenes* are identified in the order listed as pathogens from red meat and poultry which pose significant human health risks. The relative importance of these organisms varies with the species of animals moving into the human food chain and the rank order is likely to change with time.

7. New diagnostic tools for risk measurement, especially risks from microbial origin, must be found. Research to control the incidence and level of microbial contamination throughout the food chain must be supported. On-farm research needs to be implemented to identify critical controls for foodborne pathogens and contaminants. **Research and development activities must receive adequate federal funding and should be conducted where possible in university, government and industry laboratories in coordinated joint programs.**

8. There is a need to find economically feasible methods to identify animals, either individually or by lots, for effective food safety and quality programs.

9. New and reliable rapid screening technology should be developed to distinguish between live animals more suitable for marketing as raw meat and those suited for pre-cooked or pasteurized products.

10. Recognition must be given to the differences in production practices and methodologies between species for food safety purposes. Animal-to-animal contact in both confinement and non-confinement rearing may pose different food safety risks.

11. Training of personnel throughout the food chain in HACCP-based procedures must be supported by public and private agencies. Present and new employees must be trained in food safety and quality assurance programs.

12. Food safety education of retailers, consumers and preparation personnel along the food chain must be intensified with government, industry and academia forming partnerships to accomplish this objective. The Cooperative Extension Service should play a major role in this process and should mesh these educational efforts with programs on nutrition and improved food purchasing preparation and consumption practices.

13. **The overall TAG process should continue and recommendations should be updated as part of an on-going process.**

14. A national forum should be held after completion of the initial TAG process with representatives from government, consumers, industry, and academia (including TAG members) to chart a course for new food safety and quality assurance programs focusing on hazard reduction efforts in animal production systems.

15. A final recommendation is that this AP-TAG report be recognized as an initial effort that is part of the larger TAG process. **The information contained herein must be recognized as being largely based on limited**

scientific evidence. In some instances data and opinion are combined in arriving at conclusions and recommendations. Recognition must be given to this fact as this report is used to make changes in our red meat and poultry safety and quality systems.

The Animal Production Technical Analysis Team was Chaired by Dr. James E. Marion, Auburn University, Auburn, Alabama. The participating team members are as follows:

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BIOGRAPHY

In 1994, Dr. Marion served as Chairman of the USDA-FSIS-APHIS Technical Analysis Group (TAG), Track II, that assessed human food safety hazards, risks and controls in the production of red meat and poultry. The TAG report focuses on public health through good management practices in the production of food animals.

Dr. Marion has been Professor and Dean of the College of Agriculture at Auburn University since May 15, 1988. Prior to that he was Professor and Head of the Poultry Science Department at North Carolina State University's School of Agriculture and Life Sciences (1985-1988); Professor and Chairman of the Poultry Science Department at the University of Florida (1982-1985); Director of Research for Gold Kist, Inc., Atlanta, Georgia (1972-1982); Assistant Director of Research, CPA/Gold Kist, Inc., Atlanta, Georgia (1969-1972); Head, Food Science Department and Associate Professor at the Georgia Experiment Station, Griffin, Georgia (1967-1969); Assistant Professor, Food Science Department, Georgia Experiment Station, Griffin, Georgia (1962-1967). Dr. Marion was also a Graduate Assistant in the M.S. Program in Poultry Nutrition at the University of Kentucky (1959-1957), where he prepared his thesis on "High Temperature Effects on Laying Hens."

Dr. Marion has served as Councilor and member of committees and president of Dixie I.F.T.; President (1944-95), Vice President (1993-94), Southern Association of Agricultural Sciences; and past board member, President, Chairman of Industry Committee, Member of Professional Development Committee, Chairman of constitution committee, Member of finance Committee for the Poultry Science Association; Co-Chair of the ad hoc Committee on Poultry Science in North America (1990 to present). He is a current member of American Institute of Nutrition, American Association for Advancement of Science, Gamma Sigma Delta, Alpha Gamma Rho, Phi Beta Delta, Alpha Zeta and Sigma Xi. He is president of Gamma Sigma Delta, Auburn Chapter (1991-92), past member of Tri Beta, Georgia Academy of Science, American Oil Chemical Society and Agricultural Research Institute.

He is a member of the Bennett Agricultural Roundtable, past member of the Technical Advisory committee of the southeastern Poultry and Egg Association, board member and past Vice president of Alabama Agribusiness council, past member of USDA Advisory committee on Meat and Poultry Inspection and USDC Advisory Committee on Food Integrity, and Secretary, Vice President and President of Southern Region council of Administrative Heads of Agriculture, 1991, 92, and 93, respectively.

Dr. Peter E. Poss
Willmar, MN

USDA FSIS PRODUCTION TAG REPORT POULTRY

The first step in applying the principles of HACCP to food safety requires identifying all the production steps and product flow of the operation. Once the steps have been identified, the control points can be identified. This flow chart, included in the report, is entitled "Animal Production Flow Chart with Food Safety Control Points: Poultry," and provides a point of reference for the discussion in the written report.

Avian food animal species are primarily broiler chickens, turkeys, and layer chickens. They are providing 29 billion and 5.8 billion pounds of meat respectively, and 69 billion table eggs (USDA 1991). The U.S. per capita consumption from 1985 to 1992 increased 31% for broiler chickens, 61% for turkey and decreased 8% for table eggs.

A small number of primary breeding companies provide the foundation stock which are produced in a closed loop of pedigree generations under intense genetic selection pressure to provide parent stock for the multiplier breeder segment of the industry. Strain crosses provide the progeny for meat and eggs. The breeder segment of the industry uses highly protective husbandry and disease monitoring/control practices appropriate to the value and importance of the stock. The risk of business/industry interruption due to the loss of even a single diseased flock is not acceptable to the demand driven projected production. These protective practices are more stringent in the primary breeder segment where the impact on production and economics is greater than in the multiplier segment. Production is in biosecure confinement and generally operations are all-in, all-out. However, multiple stages and ages are often present on a premise.

Commercial meat bird and table egg production represents the largest phase in terms of numbers and premises and is mostly vertically integrated. Protective husbandry and disease monitoring/control practices are important. Information and training have a high priority in the integrated setting. Good health is essential to maximum productivity and the quality of product at market time. Residue quality assurance is a separate issue that is important to food safety and quality and carries a high priority for brand name protection.

Contaminants have been classified as physical, chemical and microbiological. The poultry industry has an excellent record of physical and chemical residue free production. Ongoing voluntary industry programs stimulated by the need to provide safe, top quality food and brand name integrity were developed, adopted and are very successful. Microbiological contamination, however, has not been well addressed by the industry and is the major area of concern in the current food safety effort.

Transmitters of microbiological contaminants can be categorized as progeny, feed and environment. In live production, prevention of microbiological contamination through HACCP on the farm is a huge undertaking for a federal agency. It will require coordination of governmental agencies, private sector agencies and industry. The challenge is to identify all the transmitters and non-economically disruptive control methods. Food Safety Control Points may be more user friendly to the farm setting than HACCP, which connotates terms such as regulate, quarantine, condemn, etc. The industry is driven to produce safe food, but a massive planning and training effort is required to implement the effort. An ongoing national forum is required to address the rapidly changing state of the art in livestock production each year.

The exclusion of all food pathogens from the production system is the long term goal. Since microbes can infect and multiply throughout the entire process, transmission must be interrupted at all points simultaneously forever. A more realistic strategy today is minimization and reduction of contaminated flocks, contaminated birds in a flock

and the number of organisms on and inside the bird. *Salmonella* provides the logical pathogen model since it carries the highest risk to human health, affects all species and has a large research base. Pasteurized milk can be thought of as a food safety process model where farm standards such as industry BMP's and GMP's minimize contamination and improve the quality of the raw product. Then the additional processing procedure of heat over time, which might be bacterial rinses and chill temperatures or irradiation in meat processing, assures some final safety and quality assurance.

Practical control of microbial contamination during live production will have total pathogen free food safety as the long term goal and minimizing contamination as the current short term goal. The industry has a history of federally coordinated voluntary *salmonella* control programs which can also be expected to have a positive control effect on other pathogens. Even minimizing contamination is a huge, difficult and expensive undertaking, but should be possible through the implementation of all the applicable technologies. Current technology is available to minimize contamination in feed, hatchery and breeder flocks, table egg layers, meat bird production and transportation. Priority for live production food safety research will improve the opportunities for success.

BIOGRAPHY

Peter E. Poss, D.V.M., ACPV , is a Diplomate of the American College of Poultry Veterinarians. He is a 1957 graduate of the College of Veterinary Medicine, University of Minnesota. Dr. Poss spent two years in the U.S. Army as a Veterinary Laboratory Officer at the Fifth Army Medical Laboratory, St. Louis, Missouri. He was in private veterinary practice (mixed animal) in central Minnesota for five years. He was Vice President and General Manager of Earl B. Olson Farms, Inc. (turkey production) division of Jennie O Foods Inc., Willmar, Minnesota for 25 years.

Dr. Poss is the Past President of the Minnesota Veterinary Medical Association, the American Association of Avian Pathologists and the Minnesota Turkey Growers Association. He is currently the AAAP Delegate to the AVMA.

For the past six years, Dr. Poss has been a Poultry Consultant. He is an Associate in Poultry Intellimetrics, Inc., consulting on processing plant grade improvement and condemnation reduction programs, and a consultant to independent turkey producers, feed suppliers, integrators, and the National Turkey Federation. He also has a part time appointment as Assistant to the Dean (administrative position) of the College of Veterinary Medicine, St. Paul, Minnesota, for the past year.

Dr. Beth Lautner
Vice President
Swine Health and Pork Safety
National Pork Producers Council

PORK TECHNICAL ANALYSIS GROUP REPORT

The animal production Technical Analysis Group (AP-TAG) was empaneled by the U.S. Department of Agriculture to provide an assessment of human food safety hazards, risks and controls in the production of meat and poultry. The AP-TAG was divided into ruminant, pork, poultry and risk assessment subgroups. This report will focus on the highlights of the pork section of the AP-TAG report.

Food safety assurance is largely a matter of identifying the vehicles which are likely to introduce human health hazards into the system and controlling those vehicles. Vehicles considered in the report for the introduction of microbiological and parasitic hazards included swine, rodents, birds, flies, personnel, air, pets, feed, water, trucks, equipment, clothing, fomites and wildlife. Vehicles considered in the report for introduction of chemical hazards included feed, water, drugs and additives, pesticides and farm chemicals.

The focus of the information presented will be on parasitic and microbiological hazards. It should be noted that the report also includes a detailed discussion of chemical hazards and their prevention. The specific potential pathogens to be discussed include:

Trichinella spiralis
Toxoplasma gondii
Salmonella sp
Campylobacter sp
Yersinia enterocolitica
Escherichia coli (verotoxigenic)
Arcobacter sp

For each of the above, information will be presented on transmission factors, control points, monitoring control points, desired results of control programs and future research needed.

Trichinella spiralisis: Incidence is declining from a turn of the century percent positive rate of 1.41 to 0.11 in the late 1960s. Risk factors have been identified as feeding uncooked food waste, rodents, cannibalism, fecal transmission and wild animal transmission. Animal production management control points have been identified and are being addressed through visual monitoring and periodic serological herd-monitoring. The desired results of the National Trichinae Research Project are national, regional or herd certification based on a serological monitoring and control of risk factors, with pork no longer a source of human trichinosis.

Research needed includes methods to determine:

Validity of ELISA diagnostic testing under field conditions
Risk factors for identification of positive herds
Serologic sampling protocol for operations with different levels of risk factors
Efficacy of control programs in infected herds using control points
Current national prevalence on a herd basis

Toxoplasma gondii:: Cats are pivotal in transmission and are the only definitive hosts. Positive serology in market hogs has decreased in the last 10 years most likely due to increased indoor housing and more effective use of rodenticides. Control points may include:

Prevent cat exposure to swine
Assure effective cooking of animal product food wastes
Prevent pig access to animal carcasses, etc.
Wash boots upon entry to buildings to prevent tracking of fecal oocysts
Design housing systems to minimize exposure to cats, rodents, wildlife and potential oocyst environmental contamination

Monitoring control points-steps could include visual observations, monitoring of cooking procedures, carcass removal, and periodic serological herd-monitoring.

Desired results after research needs are addressed could include herd certification based on monitoring and control of risk factors, and a continuous reduction in the national prevalence in swine.

Needed research: Determine risk factors for infection in swine.
Validate serologic test
Determine the serologic sampling protocol for operations with different levels of risk factors
Investigate on-farm intervention strategies

Salmonella : (2,379 identified serotypes--serotypes and strains vary in prevalence and ability to cause disease in pigs or people and to establish carrier state in swine)

Risk factors: transport, fasting, holding and co-mingling of pigs.

Control points: Not yet developed. Possibilities include biosecurity measures, vaccines, stress management. Monitoring of control points could include regular visual inspection of animals and operation, fecal and serologic sampling, and review of *Salmonella* programs.

Desired results could include pigs produced under a *Salmonella* control process and baseline data on excretion at various production stages.

Research needed: Define control points for *Salmonella* entry and develop prevention methods
Determine national baseline fecal *Salmonella* shedding levels
Develop strategies to minimize stress during transport
Determine reliability of serologic assays for detection of carrier swine and develop improved tests
Define mechanisms involved in establishing carrier swine
Develop model control program

Campylobacter: It is common in intestinal tract and feces of livestock, poultry, dogs, cats, and humans. Most human Campylobacteriosis is attributed to *C. jejuni*. The prevalence of *C. coli* in swine is much greater than *C. jejuni*. Neither are swine pathogens.

Research needed: Develop improved tests to identify pigs
Develop an improved test to differentiate *C. jejuni* and *C. coli*
Define epidemiology of *C. jejuni* and *C. coli* in pigs
Develop methods to reduce prevalence in pigs, if possible

Yersinia entercolitica: is common in the alimentary tract of pigs and rodents. It is more common in the mouth and tonsils than in the lower alimentary tract of pigs. It is spread by contaminated water, feed, flies, rodents, and pig-to-pig carrier. It can be carried subclinically by humans.

Research needed: Develop improved tests to detect carrier swine
Develop improved tests to differentiate between pathogenic and non pathogenic strains
Develop methods to reduce prevalence in pigs, if possible

Escherichia coli (verotoxigenic): There have been no human outbreaks attributed to consumption of pork products in the United States. *E. coli* O157:H7 has not been reported in preharvest swine. Verotoxigenic human isolates of O157:H7 can cause experimental disease in germ-free pigs. O157:H7 isolates in swine to date lack virulence attributes to cause human disease.

Research needed: Determine prevalence in swine of O157:H7 and other types of *E. coli* with attributes required for human pathogenicity
Determine if the carrier/shedder state of O157:H7 can be established experimentally

Arcobacter: Epidemiologic evidence suggests it can cause foodborne gastrointestinal disease in humans. It has been isolated from sewage, groundwater, poultry, raw pork, aborted fetuses, and from the intestinal and reproductive tracts of pigs.

Research needed: Determine prevalence in swine
Determine prevalence, severity, and sources of foodborne *arcobacter* in swine are the same as those associated with human disease
Define the epidemiology and pathogenicity of arcobacter in swine

The AP-TAG process should continue in some format to allow future research results to be added as they are available to the report. This report could then be a valuable reference document for governmental agencies, the meat and poultry industries and academia.

BIOGRAPHY

Dr. Lautner joined the National Pork Producers Council (NPPC) in April, 1991 as Director of Producer Education. In August of 1992, she assumed the position of Director of Swine Health and Pork Safety and in February 1994, she was promoted to Vice President of Swine Health and Pork Safety. She is responsible for the development and coordination of food safety programs and information as they relate to pork production and development, planning, and management of the Pork Quality Assurance Program. Her duties also include communication with producers, allied industry, and regulatory authorities on drug issues and overseeing the council's involvement in the Pseudorabies Eradication Program. She represents NPPC on the National Pseudorabies Control Board. Additionally, she participates in long range policy planning on swine health programs and drug usage/availability.

After graduating from Michigan State University College of Veterinary Medicine, Dr. Lautner joined a mixed animal practice in LeMars, Iowa. She was associated with the practice from 1978 to 1986 when she opened her

own practice, Swine Health Services. Her practice provided herd health programs and computerized records for area pork producers. In 1990, Dr. Lautner completed her master of science degree at the University of Minnesota with her research area being transmission of Pseudorabies virus.

Dr. Lautner is a member of the American Association of Swine Practitioners (ASSP), the American Veterinary Medical Association (AVMA), and the Iowa Veterinary Medical Association (IVMA). She serves on the Swine Health committee, Animal Welfare committee and the Editorial Board of the newsletter for the American Association of Swine Practitioners. In 1994, she received the Howard W. Dunne Memorial Award for outstanding service to the American Association of Swine Practitioners and the pork industry.

Dr. Bennie I. Osburn
Professor and Associate Dean
Research and Graduate Education
School of Veterinary Medicine
University of California, Davis

DR. TROUTT:
I was pleased to be a member of the TAG and had the privilege of working with, I think, some very distinguished people, and I'd like to point out suffered through the TAG process so far as the Ruminant Section was concerned, and that included Cleon Kimerling at Colorado, Bert Mitchell at FDA, Gene Gangarosa here in Atlanta, Bennie Osburn, Gary Smith at Colorado, Phyllis Sparling with FSIS, and Jack Whittier, now at Colorado State.

The Ruminant Subcommittee followed a pre-arranged format as did the other TAG Groups. This format really focused on selected subject areas regarding food safety to address those issues, and collectively, based on our knowledge, we listed the food-borne hazards of threat by commodity. We considered physical, chemical and microbiological hazards. We then divided our overall committee into groups, again along commodity lines, to provide written assessment and comment. Those written assessments were then collated, edited, revised and in some cases rewritten and expanded.

The overall process was difficult. Actually, it was in many respects a severe process in that with respect to the number of food-borne pathogens, relatively little scientific information was or is available on the epidemiology and ecology of these organisms in food animals in relation to food-borne illness, and to be as precise as we wanted to be and to offer the blueprint that we wanted to be was almost impossible, when you consider the threats, especially the microbiological threats, that we were confronted with.

The difficulty is exacerbated with respect to beef and meat from dairy animals by the scope and complexity of those food-borne commodities. We looked at what we considered as the threat organisms, also using our qualitative assessments of risk that Dr. Gangarosa and that group apprised us of. In our deliberations, we placed considerable emphasis on the necessity of prevention of transmission of the food-borne pathogens and the role of HACCP methods, and I want to emphasize that, and the role of HACCP methods or approaches in preventive programs, which could be referred to also perhaps as good management practices.

We were acutely aware of how little we knew about critical control points, especially critical control points at our area of examination, the farm, because we can talk in generalities about production environment and production, but what we're really talking about is a very complex, diverse system of farms. But we're also aware that there are general controls, such as sanitation and hygiene procedures, that can be emphasized in this farm environment or production environment, if you will, to reduce the probability of transmission, and we spent a great deal of time and energy on discussing this whole question of trying to reduce the transmissibility of these pathogen threats.

We did not believe we were drafting a "plan" for production food safety. Rather, the concept was to formulate a report detailing possible avenues and strategies and have these subjected to scrutiny, to widespread input and perhaps widespread modification. We detailed in our report for your information chemical and physical hazards, and provided detailed programmatic approaches that could be used to prevent their prevalence.

However, we also noted that the milk and dairy-beef residue avoidance program that was developed through joint efforts of the American Veterinary Medical Association and the National Federation of Milk Producers, National Milk Producers Federation, as John will point out, offers an effective model in probably all of our species, and therefore this afternoon, we won't detail that in an elaborate way for you.

Lastly, we tried to emphasize the necessity for a multi-factorial approach to prevention at the farm level, and that the approach needs to be based on scientific knowledge, widespread education, and a fundamental awareness of the absolute need to preserve the public health, that any model for the production environment should probably be driven by a reward and an incentive system rather than by any punitive intervention strategies.

DR. OSBURN:
It's my pleasure to be here, and to participate as well. Fred and I are setting up a bit of a tag-team match here. So, just as a little background, I would like to say that previous programs have been quite successful in the beef cattle and dairy cattle arenas.

We can look at successes that were brought about with the Brucella Program. Those successes being the result of regulatory processing and educational programs. Similarly, Tuberculosis Programs and control have come about, and then, as Dr. Troutt did mention, the Grade A milk or pasteurized milk ordinance has had a great impact at least on the dairy industry and, as an example, the shelf life of milk has been extended considerably from a few days up to three to four weeks now, so much of this was due to an approach to control of agents that would end up contaminating these products.

The 10-point plan has also been quite a success, and I know a plan 10 point plus that was used in California has over the last two or three years reduced the number of violative levels of antibiotic residues from around three percent to less than one percent. So, it is a demonstration that some of these programs are in fact effective and can be quite effective.

What I'd like to do is show you that even though some of these programs are in place for chemicals, we still do have problems occurring, and during this last year, there were chemical violations associated with show cattle, and this—the grand champion and the reserve grand champion at the Western Livestock Shows were in fact disqualified because they had detectable levels of anabolic steroids, Clenbuterol in particular. Similarly, at a large county fair in Oklahoma, 38 percent of the cattle entered were disqualified because they tested positive.

And even though there have been successful programs undertaken to control the appearance of residues in dairy beef, it still does occur and, unfortunately, we still have some showing up in California. I would point out that now it does appear that the number of violators is much fewer, and some of those that are repeat violators are the ones that are being picked up later.

Well, our TAG Group took into consideration the following strategies. We felt that we needed to build on existing programs, and the strategy of the HACCP or the principles of HACCP, whether we call it HACCP or something very similar to it. The basic principles that have been discussed here earlier today were an important point for us to start from. In addition, there are a number of quality assurance programs that have been initiated by various producer organizations and groups, and these do serve as a basis to continue developing these food safety strategies for the production unit. One of the most important aspects of both the HACCP and the quality assurance programs is prevention, and we felt it was important to emphasize that, and the reason that we feel this is a critical thing to be doing is that it's going to be important to reduce pathogens at slaughter, to eliminate chemicals at slaughter, and to eliminate physical defects at slaughter.

So, we mentioned that quality control programs were used. Probably 20-25 years ago, there was a major push to develop good preventive medicine programs in veterinary medicine, and many of the principles associated with preventive veterinary medicine programs or preventive health programs can be used also as a basis. The HACCP programs as well as the ISO-9000 programs are similar types of management concepts and processes that can be used in addressing food-borne hazards. Some companies, such as Campbell's Soup Company, are combining the HACCP and the ISO-9000 program in their vertically-integrated poultry units and also now in their beef programs.

I think I'll turn it back over to you, Fred, and we're going to go to beef for a little while, and then we'll come back to dairy.

DR. TROUTT:
We have chosen this afternoon not to include our flow diagrams. They're in your written document, and the reason for that was simply as a consequence of time, to not feel compelled that we had to go through everything in a detailed manner and to explain it.

But needless to say, when we're talking about the cattle industry, we're talking about an extremely large industry, so far as the scope of operations are concerned, and with a vast diversity of operations.

We're talking about almost one million cow calf operations, and almost 45 million beef cows. Some perhaps 50+ million stocker and feedlot cattle and, in our TAG Group, we addressed, as I said before, physical, chemical and microbiological hazards.

The chemical hazards that we examined as threats were drugs and additives, including under the drugs obviously anti-microbial agents. Sources could be through feed and water, also pesticides, and there's a typo, it should be herbicides, as a threat so far as food safety is concerned.

Farm chemicals, other than those herbicides and pesticides, and then in unusual circumstances, equipment serving as vehicles for the distribution of a chemical agent that could pose a food safety threat.

We quite frankly were not as alarmed about those chemical hazards as popular conceptions lead us to believe. We believe that they are a threat. We, however, also noted in our report that there's a wide-spread sampling program administered by the Federal Government that has a low rate of detection, that also commodity groups have over the last approximately decade done much through quality assurance programs, and the dairy industry as well as the pork industry and the beef industry have established those quality assurance programs focusing with their producers on the need to reduce violative residues.

We mentioned these aspects in our report, but also now focus more on the microbiological threats, and when we're talking about beef cattle from a flow diagram point of view, we really need to focus on the breeding stock that Dick McCapes referred to this morning as the progeny as well as Peter, stocker cattle and feeder cattle and the points in between those, movement, congregation, subsequent movement, and then removal to slaughter.

So, each one of these groups can be subjected to other positions within what we would describe as a flow diagram that would increase their susceptibility or the risk of acquiring a food-borne pathogen. These microbial pathogens can be transmitted through feed, water, by birds, by rodents, by other wildlife, as a consequence of movement in contaminated trucks and trailers that perhaps are not cleaned appropriately.

In certain circumstances, we believe personnel may contribute to the incidence as well as equipment. Here, we focused some attention on common equipment used in the industry at the farm level. A front-end loader, skip loader, if you will, that's used to perhaps remove or scrape manure from alley ways and then is also used to convey feed to feed bunks without an intermittent step of thorough cleaning and disinfection.

Clothing and fomites, other than what I've mentioned, may serve as a vehicle, as pets can and, in certain situations, perhaps even air.

Now, the problem to a certain degree with this list is that it becomes very speculative, that there does not seem to be concrete data that tends to demonstrate the transmission of a food-borne pathogen, especially the pathogens that we tend now to be more concerned about. Some are asymptomatic in our animal populations but cause devastating

consequences in our human population, so we want you to know that we had some concern about constructing a list like this and where it would lead because there is some speculation involved here. But you also don't want to be guilty of omission. So, we chose to be as inclusive as possible.

From a standpoint of microbiological and parasitic hazards, I'm going to ignore the parasitic hazards and recommend appropriate sections within the report, and focus more on the microbiological hazards.

To a certain extent, Drs. Poss and Lautner have already covered the threats that we consider to be microbiological hazards, and although there's going to be some variation as you look from commodity grouping to commodity grouping, by and large, there's a commonality of the enterobacteriaceae that obviously threaten all of us, and they're transmitted through animals.

Salmonella, a variety of serovars, we consider to be our major threat so far as the beef and meat from dairy cattle are concerned. *Campylobacter*, *E. coli O157:H7*, *Clostridium perfringens, Listeria monocytogenes*, and Staphylococcus *aureus*, we consider to be those organisms that we had to be extremely vigilant about.

For *Salmonella*, we considered that the prevalence in animal populations could indeed be high, but we're also aware, based upon the literature, that it's going to be variable, depending upon a specific population, the stresses that population has been exposed to, and the nature of the population, whether it's young, whether it's old, where indeed the sampling took place.

But with *Salmonella*, what is very apparent in the literature is that as you increase congregational points, and this probably has to do with all of our species, as you increase the rate of congregation, you tend to increase the risk of the animal acquiring *Salmonella.*

Campylobacter, we consider to be low to moderate in our animal populations. *E.coli*, we assumed that it was unknown. We had available to us the preliminary reports of the prevalence in dairy cattle, but, nevertheless, we believe that we did not know sufficient about *E. coli O157:H7*, and to an extent its other virotoxigenic colleagues, to assign even an arbitrary level of prevalence.

Clostridium perfringens, we considered to be high in our cattle populations, and *Listeria* low to moderate. So far as critical controls are concerned, we concluded that we knew very little about precise critical controls, especially from the standpoint of efficacy. You need to also be aware that in our deliberations, we looked at practical aspects, and we looked at cost effective aspects so far as these controls were concerned.

The efficacy of what we thought may be critical controls was largely unknown. However, we also reached the conclusion that critical controls obviously had to be HACCP-based and, as Dr. Osburn will reinforce later, we need a great deal more research to be able to be more precise in assigning critical controls to on-farm operations, and we need to know more about the epidemiology and ecology of all those organisms we listed, not just *E. coli O157:H7.*

We need to know much more about assessment of risks and then the validity of any control program that we institute at the farm level. We need identification and record systems. There needs to be additional research before a thorough HACCP-based program is instituted, and then research associated with the validation of the process and the benefit, the cost ratios, that evolve from implementation of any of these programs. Controls are going to have to be instituted—whether we institute general controls at the present time or whether we move on to more precise critical controls.

Education, we believe, is a fundamental cornerstone of any of the preventive programs without regard to species of assignment.

Some of the general controls that we could also refer to as just good management practices would include non-contaminant processes that reduce or remove contamination of our water and feed supplies. Care is needed with the introduction and source of progeny cattle, so far as transmission of an organism is concerned. Enhanced bio-security, including the movement of people and other animals on to and throughout our farm premises, and management of stress in our cattle populations is needed, especially as it relates to within the yards and lots, and what situations actually precipitate shedding or increased shedding rates of the organisms, the threat organisms, not only at the time that the animals are going to be moved, say, from the yard or a lot to a slaughter facility but within the lot itself. Then, enhanced emphasis is needed on sanitation and hygiene and effective procedures to reduce the level of the contaminating organism within the animal population and the fomites that the animal population is exposed to.

We believe that we need to take steps to always think about preserving the public health, and that we want to adopt a focus where we have a philosophy of producing food, not just producing cattle. I said previously, the programmatic approach is probably going to work much better with an incentive and a reward system as opposed to any punitive measure that could be instituted.

DR. OSBURN:
We are now going to spend a little time on veal and dairy cattle. Again, the hazards we'll discuss as we move through this—the transmitters or the sources of hazards, the principal ones—are listed here, and they consist of feed and water, personnel and the environment and facilities.

As far as the hazards that are associated with physical objects, these can be things such as needles, pellets, abscesses and the like. I think we need to take more conscious efforts in determining how we use things, such as needles. As far as the chemical hazards are concerned, as I pointed out earlier, we still have some problems with antibiotic residues. I think the 10-point plan and the quality assurance programs have a process in place now that allows us to deal with it, and one of the key things is we're finding as we're dealing with our dairymen in California, is that many of them have not been that well informed and understand the importance of this. So, there need to be additional efforts on all of our parts to inform them. Herbicides and pesticides are very important, particularly in areas where least cost rations are used and where a lot of by-product feeds find their way into these animals. Some of these find their way into milk as well as into the fat of our cattle.

The principal microbial hazards are listed here, and they consist of *Salmonella*, *Campylobacter*, *E. coli O157:H7*, *Listeria* and *Staphylococcus aureus*. *Salmonella* is one of our more common causes of human illness, as we heard today but, in addition to that, many of the *Salmonella* that affect humans also affect our livestock. So, any program that we put into place will benefit our livestock as well as the human population.

As I mentioned, one of the most important things about the processes we've been talking about are prevention, and we've touched on a number of these today, but at least in the area of dairy cattle and veal, we feel that feed is an important source, and particularly recycled feeds, recycled animal products, for instance, or feeds that have not been protected from various types of rodents and other types of transmission. Again the front-end loader is another example, where it's used to scoop alleys and then used also to feed.

Water is another potential source, and there's surface water, and there's ground water, and we find often cattle like to drink waste water. It must have high salt content or something of this nature. So, they may in fact be out there sampling some of this out in their pens. Recycled waste is also very important as is personnel, environment, animal management and education.

Recycled waste is something that is becoming more common, and in Western United States on large dairies, there have been attempts to compost this waste before it's recycled and used for bedding. However, we also have

evidence that some of this composting isn't as effective as we thought, and it is an excellent way of recycling *Salmonella* and keeping it as a persisting organism on production units, particularly when it's used for bedding.

Water is another important source, and again I did mention something about water. Some of it is used and recycled to wash down alley ways and things of that nature. If some water is standing, some cattle will have a tendency to drink it. There's increased emphasis, particularly because of Cryptosporidia and some of the other organisms, to use ozone as a means of controlling that, or even filtration. These are ways in which it is possible to begin to control the organisms.

As far as prevention is concerned, personnel training is very important, and on many large production units, individuals have not been all that well trained in sanitary measures, and sometimes we have labor that comes in from other countries that have practiced different sanitary standards than we do, and so it becomes very important that educational programs be put in place. We also need to emphasize, as we've been talking about here, the importance of microbes, the way that they are able to persist, and the importance of sanitation and controlling them.

As far as the environment is concerned, you've heard about bio-security. Housing systems. Dr. McCapes pointed out that over the next 30 or so years we may have to begin to look at different housing designs or ways in which we manage animals. We can keep them in more sanitary environments, and vehicle and human traffic definitely needs to be monitored. As far as animal management is concerned, let me give you an example of what one of our faculty members, Brad Smith, has been working on. It looks like it is very important and has potential for being a very good *Salmonella* control program. He's looking at *Salmonella Dublin* in particular.

There are a number of things that he takes into consideration here, but he has developed a serologic assay that will identify carrier cattle, and he is able to identify these animals and remove them from the premise. To do so, you have to set up a HACCP-type program or a critical control program, which includes checking the source of the incoming animals and, if you know a particular premise or source of animals is clean, they may only have to stay in quarantine for a short period of time before they're integrated into the herd. But during that time, those animals will be serologically tested or they can be tested on milk samples, and those that do appear to be clean and not carriers are permitted to integrate into the herd. We also know that transport is an important way, particularly if animals are mixed, in which contact is a good way of spread.

Another great place, if you remove an animal from a milking string or a pen and put in a hospital pen, you often end up mixing it with other animals and, by contact, there may be transmission of infection. Then, there have been vaccination strategies that have worked in helping control *Salmonella* and, in fact, there's some indication that where some of these vaccines have been used in some European countries there has been, in addition to reduction in the animal of at least the cattle *Salmonella* problems, a concurrent decrease in human *Salmonella* cases.

I think one of the major things that we have to do is educate personnel, and this means from the producer or the owner to the farm manager. It may be one and the same or it may be a different individual. There's a need to identify individuals that will serve as critical control managers; in other words, those individuals that are responsible for overseeing the HACCP principles on a production unit.

On large operations, there may be different individuals that are involved in feeding. Others that are involved in milking also have to be trained. Many of these in our part of the world speak Spanish and do not understand English. So, it means that we have to communicate with them and set incentives in place for those people to understand how they are to operate on these units. There may be hospital doctors. These are the ones that are often out there administering medications. They have to be trained, and they have to understand the responsibility that they have on these production units.

Veterinarians. We've heard that in the Netherlands, they have a certification program. We think that is important for our veterinarians here, and maybe that should be part of the accreditation process in the future. But there is a need to bring the practicing veterinarians on board as well as those that participate in regulatory activities.

Livestock haulers and those that are involved in buying and selling have to become educated as to the principles and the role that they need to play. You can see this is a major undertaking, one in which educational materials have to be developed, and they have to be pitched at the right level for the individuals that participate on the production units. What are some of the things that we see as gaps in knowledge? They could also be called research objectives. Not every organism or every chemical will necessarily fit one single HACCP or quality assurance program.

We need to be able to devise programs. Some good model systems need to be developed, and then we need to begin to put those in place so that both producers, veterinarians and eventually the processing units, whether they be slaughter houses or milk processing, processors understand what the product is they're getting from the production unit. Precise prevention strategies need to be developed again for the various types of hazards or contaminants we're dealing with. We need to develop more efficient monitoring systems. It was mentioned that Dr. Weaver has developed a system that allows for monitoring the amount of antibiotics that are administered. Developing computer-based systems may be of help in this regard and, similarly, effective record systems, so that you measure or at least have records of what has been going on. Risk analyses, risk assessment models, need to be developed for each of the different contaminants or hazards.

We really need the cost benefit, and I mentioned that there has been some in dairies that have quality assurance programs where there's recordkeeping and monitoring of the use of antibiotics.

There's been a 70 percent reduction in the use of antibiotics, and those costs have added up over the course of the year. So, the benefit of those types of programs are important. I think one of the critical things is how do we dispose of animals. We heard earlier today that it may be possible to use the process of cooking or pasteurization, like they do with eggs, to handle those animals that are identified as being contaminated.

More work needs to be done, and I think groups need to get together—processors, producers and veterinarians and regulators—to sit down and develop the strategies for how these positive animals are going to be handled in the future. And then we need to determine what is really important for controlling contamination during transport. Some of this will definitely involve looking at ways in which you can reduce stress on animals, because it does appear stress is a means of actually helping activate some of the pathogens we've been discussing.

So, we'd like to end up by just saying that in order to address this, we feel it's important to utilize some of the principles that we've heard about today—some of the principles associated with the HACCP model, the quality assurance programs, and prevention, rather than waiting until after problems have arisen. By doing that, we should be able to reduce the microbial pathogens at the time of slaughter and eliminate both the chemical and physical hazards or contaminants that may find their way into the food chain.

BIOGRAPHY

Dr. Osburn earned his BS and DVM degree at Kansas State University. In 1965, he completed a Ph.D. degree in Comparative Pathology at the University of California, Davis. From 1964 to 1968, he served on the faculty at the College of Veterinary Medicine, Oklahoma State University, and from 1968 to 1970 he was a Post-doctoral Fellow at John Hopkins University Medical School in Baltimore, Maryland. In 1970, Dr. Osburn returned to the University of California, Davis and joined the Department of Pathology. He has been Associate Dean for Research and Graduate Education Programs since 1976.

Dr. Osburn's research area of expertise is in viral immunopathology with particular interests in congenital diseases and the pathogenesis of viral diseases. Current research interests with these viruses include the use of recombinant DNA technology for diagnostic and viral genetic studies, viral pathogenesis and public policy. Over the last ten years, he has applied major effort to designing and implementing preharvest food safety programs.

Dr. Osburn has served as president of the American College of Veterinary Pathologists, the American Association of Veterinary Immunologists, and the Conference for Research Workers on Animal Diseases. In 1988 Dr. Osburn was appointed by Secretary of Agriculture Ed Madigan to serve as the first Chair of the Agricultural Biotechnology Research Advisory committee (ABRAC) for Science and Education and served in that capacity through 1992. From 1987-1989, Dr. Osburn served as a member of the Blue Ribbon Panel which was charged with comprehensive review of the USDA's Animal Plant Health Inspection Service; from 1983-87, Dr. Osburn served as a member and later as Chair of an NIH Study Section for the Animal Resources Branch, division of Research Resources; he served as chair of two workshops on Animal Health Research in American Agriculture Research hosted by The Association of American Veterinary Medical Colleges (AAVMC) and held at the Winrock International conference Center in Morrilton, Arkansas; co-chaired two workshops on Critical Issues in Animal Health Research hosted by the AAVMC; chaired and co-chaired a number of committees for the American Veterinary Medical Association (AVMA), Council on Research; served as a consultant for the U.S. Agency for International Development on biotechnology issues and for promoting international collaboration; served as a member of a scientific review panel for health effort issues for the Environmental Protection Agency; served on two occasions as a consultant for the Office of Technology Assessment; served as chair and co-chair of two international symposia on bluetongue, African horse sickness and related orbiviruses, the first held in the US; the second at the Office of International Epizootics (OIE) in Paris, France; and served as co-chair of the 12th International Symposium of the World Association of Veterinary Microbiologists, Immunologists and specialists in Infectious Diseases (WAVMI) held at UC Davis in 1992 and co-chair of the 13th Symposium in Perugia and Mantova, Italy.

Dr. Osburn is currently serving as chair of the AAVMC Budget Committee; chair of the Agricultural Appropriations Committee for the Board of Veterinary Medicine; chair of the Board on Veterinary Medicine; serves as budget representative for veterinary medicine on the Experiment Station Committee on Policy (ESCOP), the Joint Council and the National Agriculture Research committee (NARC). He also chairs the Bluetongue Diagnosticians, and the Bluetongue and Bovine Retrovirus committee of the U.S. Animal Health Association. Since 1988 he has been a Director of the Food Animal Production Medicine Consortium. Dr. Osburn was recently appointed as liaison between the School of Veterinary Medicine, UC Davis and The California Dairy Foods Research Foundation. He recently coordinated two workshops on Preharvest Food Safety and two training workshops on implementing preharvest food safety.

Dr. H. Fred Troutt
University of Illinois
Urbana-Champaign
Chairman, Food Animal Production Medicine Consortium

BEEF FROM TAG

In the United States, the beef cattle industry is large in scope and complex in diversity of operations and movement of animals. Beef cattle can be involved with physical, chemical, and microbiological hazards that contribute to food safety problems. Feeder cattle are subjected to a variety of stresses (including transportation, changes in feed and water, changes in housing, exposure to other cattle, inclement weather, and handling) but can contribute to acquisition of food safety hazards. Contemporary concerns must focus on the role of microbiological food safety hazards but include *Salmonella sp., Campylobacter sp., Escherichia coli O157:H7, Clostridium perfringens, Listeria monocytogenes,* and *Staphylococcus aureus.* The control of these microbiological food safety hazards can be facilitated through preharvest pathogen control-reduction programs that utilize Hazard Analysis Critical Control Point paradigms based on risk assessment. Extensive on-the-farm and pre-slaughter research will be necessary in order to test and validate, under a variety of management conditions, cost-effective critical controls for the food-borne pathogens, some of which demonstrate no clinical disease in cattle. The research must include practical electronic animal identification and record systems. In order to optimize public health, this research needs to be implemented immediately. However, a variety of general and practical pathogen reduction and preventive procedures should be utilized now in pre-slaughter quality assurance programs. These general controls can include a variety of processes and procedures tailored to a specific pre-slaughter operation, including protection of food and water from contamination by food-borne pathogens, enhanced biosecurity, reduction of stress in cattle, and widespread use of protocol-based sanitation and hygiene procedures. Additionally, there needs to be increasing emphasis on the education of personnel in all segments of the beef cattle industry on the prevention of food-borne pathogens. Preharvest food-safety strategy should focus on incentives and rewards rather than penalties.

BIOGRAPHY

Dr. H. Fred Troutt is a 1958 graduate of The Pennsylvania State University, and in 1962 the School of Veterinary Medicine, University of Pennsylvania. From 1962 to 1964 he was engaged in private practice, predominately dairy, in Quakertown, Pennsylvania. In 1964 he joined the faculty of the Department of Veterinary clinics at Purdue University and in 1967 received a Master's degree from that institution.

In 1970, as a NIH Special Postdoctoral Fellow at the University of Missouri, he earned a Ph.D. degree in Comparative Pathology and joined the faculties of the Department of Large Animal Medicine and Surgery and the Department of Veterinary Pathology at the College of Veterinary Medicine, University of Georgia. At Georgia, Dr. Troutt established herd health programs for both cattle and swine. In July 1975, Dr. Troutt was appointed Professor and Head of the Department of Veterinary Science at Virginia Polytechnic Institute and State University in Blacksburg, Virginia. He participated in the founding of the Virginia-Maryland Regional college of Veterinary Medicine and served at the college as Acting Chairman of the Department of Large Animal Studies, as Associate Dean for Research and Service, and also as Assistant Director of the Virginia Agricultural Experiment Station. In 1986 Dr. Troutt accepted the position of Director of the Veterinary Medicine Teaching and Research Center at the University of California, Davis, also holding appointments as professor in the Department of Medicine as well as in the Department of Epidemiology and Preventive Medicine, School of Veterinary Medicine.

In 1988, Dr. Troutt moved from the University of California-Davis to become Head of the Department of Veterinary Clinical Medicine and Professor of Veterinary Clinical Medicine at the College of Veterinary Medicine at the University of Illinois.

Dr. Troutt is the author or co-author of numerous scientific papers and articles and a frequent lecturer to both producer and veterinary groups. He has served as a consultant to academic institutions, industry, and a variety of governmental agencies. He is a Diplomate of the American College of Veterinary Nutrition and an Honorary Diplomate of the American Board of Veterinary Practitioners. He is the recipient of the Norden Distinguished Teaching Award and the American Association of Bovine Practitioners Award for Excellence in Preventive Medicine. Dr. Troutt is currently Chairman of the Food Animal Production Medicine Consortium and was Principal Investigator of the Interinstitutional Food Animal Production Medicine Program funded by the Pew National Veterinary Education Program. He is a member of a variety of professional organizations including the AVMA, ADSA, AASP, AABP, and the AAFHV.

Dr. Troutt's areas of research include metabolic and infectious diseases of cattle and swine and food safety pathogens including *Salmonella* and *Yersinia enterocolitica*. He has extensive experience in instruction and research, and has extensive experience and has extensive clinical experience at the farm level in various regions of the United States—East, Southeast, Midwest, and West coast.

DAY 2
MAY 24, 1995

Commodity Research Workshops:
Poultry, Swine, Diary/Veal, and Beef

Commodity Animal Production Workshops:
Poultry, Swine, Dairy/Veal, and Beef

Research Workshop

SUMMARY OF COMMODITY RESEARCH WORKSHOPS—A.M.

The Animal Production Food Safety National Forum morning workshops on May 24, 1995, focused on research concerns for each of four animal commodity species: dairy beef/veal, beef cattle, swine, and poultry (including table egg production). There was an average of 40 people from diverse backgrounds in each workshop. Each workshop had at least two co-chairs: one with a commodity-oriented background and one with a research background. These co-chairs were assisted by one representative of the FSIS Animal Production Food Safety Program staff and an USDA facilitator.

Three questions were posed to each workshop:

1. Identify current research initiatives, gaps in scientific knowledge, and research priorities for on-farm, marketing, transport, and pre-slaughter preparation animal production food safety.

2. Suggest areas for highest priority research.

3. Review existing funding from both public and private sources.

Although each of the commodity research workshop discussions were confined to species, specific research issues, common threads emerged. Among these shared commonalities were the following:

* Research funding should be borne by all stakeholders;

* Collaboration and coordination are key;

* Interventions need to be focused at the slaughter plant while research is being conducted on pre-slaughter aspects of animal production;

* Research and recommendations must take into account the present structure of the relevant industry;

* We need to find accurate and cost-effective diagnostic tests for and conduct studies on a wide range of microbial foodborne pathogens;

* The impact of good production practices and specific interventions on the shedding of pathogens and ultimately on public health is a high priority;

* Animal management practices should be evaluated in relationship to pathogen shedding;

* There is a need for basic, clinical and observational research in the live animal area;

* Research gaps are numerous, but the most commonly mentioned are microbial dynamics/ecology; animal management and handling; epidemiology; and rapid, reliable diagnostic testing methods;

* Presently there are minimal pathogen prevalence studies in animal populations;

* Standardization of diagnostic tests and sampling methodologies is needed;

* EVERY GROUP AGREED THAT THERE IS A NEED TO KNOW WHETHER CHANGES IN ANIMAL PRODUCTION PRACTICES TRANSLATE TO DECREASED PUBLIC HEALTH RISKS FOR THE CONSUMER.

Note: The term **"on-farm"** refers only to live animal production on the farm. It does not include aspects of production included in animal production areas beyond the farm such as transportation, marketing, and feedlots or pre-slaughter practices.

The term **"animal production food safety"** refers to all animal production practices from the farm to slaughter or for eggs transported to processing plants.

DAIRY BEEF/VEAL RESEARCH WORKSHOP
MAY 24, 1995
MORNING SESSION

Co-Chairs: Dr. Jane Robens, USDA, Agricultural Research Service
Dr. Tom Besser, Washington State University

Staff Coordinator: Margaret Webb assisted by Dr. Bennie Osburn, University of California, Davis.

Facilitator: Mike Tuck, USDA, APHIS

Topic 1: Identify current research initiatives, gaps in scientific knowledge, and research priorities for on-farm, marketing, transport, and pre-slaughter preparation animal production food safety.

Dr. Tom Besser presented a review and analysis of current research and research needs. He related that studies on the ecology and epidemiology of *E. coli*, *Salmonella*, and *Campylobacter* in cows (both healthy and sick) and veal calves can be categorized under three areas:

from farm to slaughter
identifying at-risk groups (human disease)
on the farm.

With current test methodologies, immuno-magnetic testing is the most sensitive, but poor for large scale use. Conventional bacterial cultures on plated media (Sorbitol McConkey) after broth enrichment are best for large-scale projects.

In terms of the ecology of pathogens in the production environment, Dr. Besser noted that studies are being conducted to determine the role of the asymptomatic carrier (animal) in the transmission of human disease and what data is needed to identify animal production sources of human disease. Thus far, he said, we can find cattle shedding in 70-80 percent of premises, and pronounced seasonal shedding (7 X in warm seasons).

A proposed epidemiologic approach to pre-harvest *E. coli O157:H7* control would include identifying plausible risk factors, time frames and enteric effects, prospective evaluations between and within herds, and experimental evaluations. Longitudinal studies have found that most cattle shed detectable numbers of *O157:H7* for less than two months.

In the area of pathogenicity/virulence/physiology/genetics, studies on colonization factors are needed. Dr. Besser suggests using human disease information to focus pathogen/species research priorities.

For live animal production HACCP, he said we need to know what is the impact of good production practices on the potential for production animals to serve as a source of human foodborne disease, and what intervention strategies can be implemented.

In proceeding towards steps to control hazards, Besser stressed that "it is less important to know what the National prevalence is than what an intervention does...therefore, traceback does not play an important role."

In summary, the possible means of pathogen hazard control so far are:

1. Eradication, as with bovine tuberculosis, is impossible for most food borne pathogens;

2. Universal testing through routine farm inspections (extremely expensive and not likely to work, given current knowledge);

3. Vaccination of live animals (too little information to presently evaluate, but probably unlikely)

4. Pre-slaughter measures in the environment and in the diet (may provide the most benefit the soonest)

5. Ecology through "niche engineering," reducing feed contamination, and competitive exclusion (second best after "4").

Topic 2: **Suggest areas for highest priority research.**

Discussion highlights: Workshop participants generally agreed that there is a need for tests for other microbes such as Salmonella, campylobacter, etc. Are there other verotoxigenic *E. coli* which cause diarrhea in humans? We need to compare the genetics of human and animal agents--how and when they become problems. To avert the "danger of looking for keys under the lamp-post", we need to look at a large number of agents.

Participants agreed that to succeed in any program, we need to link animal well-being and production potential to provide incentive to farmers to participate in programs designed to reduce pathogens.

There was a general consensus that there is a need to focus interventions at the slaughter plants and pre-slaughter treatments while research is being done. Is the cause the input of cattle to slaughter or is it the processing/handling causing the problem? An infrastructure is already in place in the marketing and pre-slaughter phase, so we can start there. However, traceback from the plant back to the culled animal or treating the animal as it leaves the farm is presently unworkable and impractical.

In regard to implementation, the group stressed that: (1) any research and recommendations need to take into account the present structure of the industry (example--we need to have a workable system for the slaughter of cull cows, which often come singly from any given farm--handling these animals presents entirely different problems from that of large lots of feeder steers); and (2) best management practices as tied to quality assurance must be in place before introducing HACCP.

Farm to slaughter research gaps identified by the participants include: microbial dynamics (i.e. hide contamination), management (feed, water, transport, co-mingling, etc.), and infrastructure (dealer, hauler, markets).

In addition, is there an association between ionophores/drugs for on-farm use and human disease? Where is *E. coli* on the carcass? These are questions that need answers.

One participant stressed that we must develop ways to treat the hazard rather than treating markets as the hazard. We must develop methods and recommendations for control of microbes at feedlots and markets.

In summary, we should:

- develop HACCP mode
- identify CCPs based on ecological information
- study animal management, including auction, transportation, and pre-slaughter handling
- use *Salmonella* as our priority pathogen for intervention

- get more information on *E. coli* and verotoxogenic strains
- provide education throughout the system the ill cow--is it a threat?
- investigate on-farm, on-animal group strategies, and
- determine if there is a class of animals associated with human disease risk--i.e., culled cows, etc.

Research Priorities:

Dr. Robens summarized the research priorities as follows:

1. Epidemiology and ecology: We need to delineate the reservoirs for pathogens. Epidemiological and ecological information forms the very necessary basis for making recommendations for best management practices for animal production. The fact that *E. coli* shedders can be found in 70-80 percent of premises reduces the incentives for traceback from infected product. Asymptomatic carriers and transmission modes are important to understand. *Salmonella, Campylobacter*, and verotoxogenic strains of *E. coli* all are priorities.

2. Methods development: There were differing views on whether we need to emphasize methods development in order to carry out the needed epidemiology and ecology. Certainly less expensive methodology would allow a greater number of tests to be conducted but epidemiological studies are not dependent on rapid methods. Also, we don't generally need methods to unequivocally identify single infected animals.

3. Genetics of the human/animal pool of *E. coli* that are pathogenic: We need to know which *E. coli* recovered from animals are found in human outbreaks.

4. We need to study the impact of good production practices and specific interventions on the shedding of pathogens, particularly *E. coli O157:H7*. We need to understand shedding patterns of culled cattle, develop a workable system for culled cattle, and define BMPs of handling culled animals.

5. Improved practices in the pre-slaughter area, including transportation: The impact there can be great, particularly from improved environment and diet.

In regard to implementation, the group stressed that:

1. Any research and recommendations need to take into account the present structure of the industry. Example: We need to have a workable system for the slaughter of cull cows, which often come singly from any given farm. Handling these animals presents entirely different problems from that of large lots of feeder steers.

2. Best Management Practices as tied to quality assurance must be in place before introducing HACCP.

Topic 3: Review existing funding from both public and private sources.

Workshop participants agreed that funding for research should be borne by all stakeholders:

Industry
Commodity groups (local)
International Life Sciences Institute
USDA—competitive grant program

USDA—APHIS group and area AVICs and VMOs
FSIS to serve as a bridge to research agencies (team concept)
National Meat and Livestock Board (check off systems)
National Diary Board (redirect)
States
Federal : USDA—ARS, APHIS, and CSREES (peer evaluation)
NRI
Need program grants
NIH—PFPs (test development? 10%)
FDA—CDC
NIH

We need to build bridges between FSIS and other groups funding or conducting research. Collaboration between all groups is necessary to make the best use of scarce resource dollars. FSIS can serve as a bridge builder among all groups.

Peer evaluation is important for all research--all funding groups should include such a process as they develop Request for Proposals (RFPs), and review and award proposals.

Dr. Robens listed ARS current research:

Location	Target	$ in thousands
Ames, Iowa	*E. coli O157:H7*	$500
	immunity enhancement	$900
Clay Center, Nebraska	*Salmonella & E. coli*	$350
Beltsville, Maryland	*Cryptosporidia*	$300

Also, bovine diseases having general food safety interest at Ames, IA; Pullman, WA; Laramie, WY; and Beltsville, MD. (brucellosis, tuberculosis, Johnes disease, mastitis, anaplasmosis and blue tongue).

For more information on ARS—animal production research, please see the Beef Research Workshop Report that follows.

BEEF RESEARCH WORKSHOP
MAY 24, 1995
MORNING SESSION

Co Chairs Dr. John Galland, Kansas State University
Dr. Dee Griffin, University of Nebraska, Clay Center
Dr. Irene Wesley, USDA, ARS

Staff Coordinator: Dr. Charles Stoltenow

Facilitator: Jerrold Gettleman, USDA, FSIS

The workshop participants did not specifically answer the three questions presented:

1. Identify current research initiatives, gaps in scientific knowledge, and research priorities for on-farm, marketing, transport, and pre-slaughter preparation animal production food safety.
2. Suggest areas for highest priority research.
3. Review existing funding from both public and private sources.

Participants provided the following summary opinions:

More research (basic, clinical, and observational) must be done in the live animal area of food safety. Collaborative efforts are needed to adequately define, assess, and conduct research on all aspects of the farm to table continuum.

For on-farm research, the workshop participants defined management practices, the role of animal identification, nutrition, including the effect of feed withdrawal, and ecology/environment as key research areas. For market channels, participants indicated that points of concentration, types of marketing (direct vs. auction), time and distance traveled, and continuity of identification as areas for evaluation.

Participants noted that it is important to not limit research to only one pathogen, but to maintain monitoring and surveillance for emerging issues--for example, looking for other verotoxigenic bacteria and other *Salmonella spp.*

The group stressed the need for different types of research for:

- standardization of methodologies,
- epidemiologic studies consisting of case-control, observational, clinical, and risk factor analysis,
- benefit/cost analyses including cost of false positives/negatives and costs of interventions or prevention measures, and
- tolerance levels (including what will be tolerated).

Dr. Irene Wesley submitted the following paper, jointly prepared with Dr. Mark Rasmussen, in response to the first question asked of the workshops. Both Drs. Wesley and Rasmussen are with the USDA-ARS-National Animal Disease Center, 2300 Dayton Road, Ames, Iowa 50010.

On-farm pathogen reduction food safety efforts are targeted on the foodborne agents which have a significant impact on human health. Table 1 summarizes the number of cases reported annually and the financial toll of human illness for these bacterial pathogen.

TABLE 1: 1992 ESTIMATED ANNUAL COSTS FOR SELECTED FOOD-BORNE PATHOGENS IN THE US.

PATHOGEN BACTERIUM	CASES	DEATHS	COSTS (MILLION $)
Salmonella	1,920,000960	1,920	$1,188-1,588
Campylobacter jejuni/coli	2,100,000120	360	907-1,1016
E. coli O157:H7	7668-20,448145	389	216-580
Listeria monocytogenes	1,526-1,581378	433	209-233
PARASITE			
Toxoplasma gondii	2,090	42	2,628
Trichinella spiralis	131	0	0.88
Taenia saginata	894	0	0.2
Taenia solium	210	0	0.1
TOTAL			**$5,000-6,000**

The bacterial zoonotic foodborne microbes have also been identified by CDC in the Healthy 2000 document for reduction by the year 2000. Reduction of these pathogens on the farm will translate to a decrease in human morbidity. The 1987 baseline data in terms of cases per 100,000 attributed to these pathogens and the goal to be realized by the next millennium are given in Table 2.

TABLE 2: HEALTHY PEOPLE 2000 TARGETED REDUCTION OF MAJOR FOODBORNE PATHOGENS

CASES (PER 100,000)	1987	2000
Campylobacter jejuni	50	25
Salmonella spp.	18	16
E. coli O157:H7	8	4
L. monocytogenes	0.7	0.5

In addressing the major food safety concerns for swine, poultry and beef, the Technical Advisory Group (TAG) final report recommended (Item 15) that:

A national forum should be held after completion of the initial TAG process with representatives from government, consumers, industry and academic (including TAG members) to chart a course for new food safety and quality assurance programs focusing on hazard reduction efforts in animal production systems.

The task today is to summarize some of the research currently conducted in private industry, federal government, and universities. For it is only when we know where we have been, that a new course can be charted.

PRIVATE INDUSTRY

The National Cattlemen's Association (NCA) has responded to the increase in reported human cases of *E. coli* O157:H7 attributed to consumption of beef. The beef industry's major research priorities, emerging from the Beef Blue Ribbon Task Force, are summarized in Table 3. A video summarizing the NCA's research priorities and research efforts in reducing the prevalence of this pathogen in beef can be obtained from NCA Denver headquarters (303-694-0305). The NCA has developed a research matrix to monitor progress in six research areas: pre-harvest, carcass decontamination, grinding, processing, retail and education. This research summary, which is presented in Table 4, is a model for coordinating research efforts for other livestock commodity groups. Researchers are encouraged to complete the survey, which is appended to this report, requesting project updates and return them to Nick at the National Livestock and Meat Board
(FAX 312-467-1672).

TABLE 3: NATIONAL CATTLEMEN'S ASSOCIATION (NCA) BLUE RIBBON TASK FORCE EXECUTIVE SUMMARY AND RECOMMENDATIONS.

RECOMMENDATIONS

- Conduct research and obtain more data regarding host/pathogen relationships between the bovine and *E. coli* O157:H7.
- Identify factors outside the bovine reservoir that contribute to the prevalence or maintenance of contamination.
- Establish and maintain an industry-driven beef safety information center.
- Review existing and conduct new epidemiologic studies.
- Develop accepted and standardized methods of sampling and detecting *E. coli* O157:H7.
- Encourage private industry and USDA to develop rapid detection tests for *E. coli* O157:H7 and other pathogens.
- Develop trace-back capability from cattle to the last point of production (through lot or individual animal identification) to enhance epidemiologic research in the case of human outbreaks.

TABLE 4: THE RESEARCH MATRIX ADAPTED FROM THE NATIONAL CATTLEMEN'S ASSOCIATION BLUE RIBBON TASK FORCE

Pre-harvest	Carcass	Grind	Process	Retail	Education
Dev DNA/PCR	Intervention Pathogen Map		Dry Sausage	Intervention	
Surveillance	Pre-evisceration	Sampling	Irradiation	Survey	
Adhesion	Steam Vacuum	Sub lot	Restructured	Time/Temp	
Feedlot	Steam Pasteurization	Survey			
Incidence	Super Steam	Intervention			
Infection	Spray Set	Rapid Test			
Vectors	Pathogen Map	Model			
Management	Hide Wash	Equipment			
Survival	Zero Tolerance	Packaging			
Models	Wash/Trim				

FEDERAL GOVERNMENT

Pathogen reduction efforts in the federal sector are on-going in the U.S. Department of Defense, Department of Health and Human services, including Food and Drug Administration and the Centers for Disease Control and Prevention, and the Department of Agriculture. USDA preslaughter activities are concentrated in APHIS and in the Animal Production Food Safety division of FSIS. USDA agencies which are contributing to research to achieve preharvest pathogen reduction in beef include:

- Agricultural Research Service (ARS)
- Cooperative States Research Education and Extension Service (CSREES)

ARS, the research arm of USDA, is committed to pre- as well as to post-harvest pathogen reduction studies in cattle, swine, and poultry. For beef, the USDA-ARS laboratories and the zoonotic foodborne pathogen studied at each institute are listed in Table 5.

CSREES programs which support beef pathogen reduction research include the National Research Initiative, the 1890 Institution Capacity Building Grant program, and the tristate Food Safety Consortium. The universities of the CSREES supported tristate Food Safety Consortium focus on beef (Kansas State University), swine (Iowa State University), and poultry (University of Arkansas).

TABLE 5: USDA-AGRICULTURAL RESEARCH SERVICE (ARS) LABORATORIES STUDYING FOODBORNE PATHOGENS TRANSMITTED IN BEEF. LABORATORIES WITH A PRESLAUGHTER EMPHASIS ARE LISTED.

USDA-ARS LABORATORIES
CATTLE PREHARVEST FOOD SAFETY

LIVESTOCK AND POULTRY SCIENCE INSTITUTE
Beltsville, Maryland
Tom Sexton, Director (301)504-8431

- *Cryptosporidium*
- *Taenia saginata*
- *Toxoplasma gondii*

MEAT ANIMAL RESEARCH CENTER
Clay Center, Nebraska
Danny Laster, Director (402-762-4109)

- *E. coli* O157:H7
- *Salmonella*

NATIONAL ANIMAL DISEASE CENTER
Ames, Iowa
Tom Walton, Director (515-239-8201)

- *Brucella* sp.
- *Campylobacter jejuni, C. coli, C. fetus*
- *Cryptosporidium*
- *E. coli* O157:H7
- *Listeria monocytogenes*
- *Mycobacterium bovis*
- *Mycobacterium paratuberculosis*
- *Salmonella*

To assess and to streamline pathogen reduction efforts in USDA, Veterinary Services (VS) within APHIS organized four Focus Groups. The three which addressed pathogen reduction in beef are indicated below with an asterisk.

USDA FOCUS GROUPS

**E. coli* O157:H7 IN CATTLE
SALMONELLA ENTERITIDIS
**OTHER *SALMONELLA, CAMPYLOBACTER*, AND OTHER EMERGING FOOD ORGANISMS
**ZOONOTIC PARASITIC DISEASES

Focus Group members represented ARS and APHIS epidemiologists, field veterinarians, and microbiologists who brought to the discussions their own research data and the accomplishments of their colleagues in universities and

private industry. The goal of each group was to explore, to develop and to prioritize researchable questions. The Focus Group summary reports, which were completed in November 1994, nearly a year after convening, assigned research priorities as follows:

I. Areas of greatest concern to preharvest food safety
II. Areas of increasing concern

An abbreviated synopsis of each group's recommendation is given in Table 6. Dr. Charles Stoltenow (303-490-7832) of the Animal Production Food Safety division is coordinating Focus Groups' activities.

TABLE 6: SUMMARY REPORTS OF THE USDA-APHIS FOCUS GROUPS.

PREHARVEST FOOD SAFETY RESEARCH PRIORITIES
Preharvest Food Safety Project Team
Veterinary Services, APHIS

RESEARCH NEEDED TO SOLVE THE PROBLEM

I. AREAS OF GREATEST PREHARVEST FOOD SAFETY EMPHASIS
   A. *Escherichia coli* O157:H7
   B. *Salmonella enteritidis*

II. AREAS OF INCREASING CONCERN
   A. Other *Salmonella*, *Campylobacter* and emerging food-borne organisms
   B. Zoonotic Parasitic Diseases

III. AREAS OF GREATEST PHFS EMPHASIS
   A. *Escherichia coli O157:H7*
      1. Characterization of the effect of management factors on the colonization of cattle with *E. coli O157:H7.*
      2. *E. coli O157:H7* prevalence studies of cattle of each slaughter class immediately prior to slaughter.
      3. Epidemiologic characterization of premises with high prevalence of *E. coli O157:H7.*
      4. Improved diagnostic techniques for *E. coli O157:H7.*

   B. *Salmonella enteritidis*
      1. Determination of risk factors-cleaning and disinfection; rodent and vector control; molting; biosecurity; use of HACCP.
      2. Epidemiology-dynamics of transmission; pathogenesis; surveys to determine incidence, prevalence, and distribution in egg layer flocks.
      3. Molecular biology-determination of virulence/invasiveness; plasmid analysis; phage typing, PCR.
      4. Development of diagnostic tests-use of ELISA/monoclonal antibodies.

IV. AREAS OF INCREASING CONCERN
   A. Other *Salmonella, Campylobacter* and emerging food-borne organisms.
      1. Epidemiologic and ecologic on-farm studies to determine extent and distribution of *Salmonella* problems (prevalence survey).

2. Characterization of epidemiology of foodborne *Salmonella* during various phases of livestock production for each commodity.
3. Identification of management-related farm-level risk factors for infection.
4. Improvement of diagnostic methods as needed or emerging pathogens for use in quality assurance programs and epidemiologic studies.

B. Zoonotic Parasitic Diseases
1. Validate existing (*Trichinella*) serologic test method (ELISA) under field conditions.
2. Conduct on-farm epidemiologic study to determine incidence of *Cryptosporidium* and its environmental impact. This is an emerging problem with potential EPA action impacting animal production.
3. Pilot studies to detect *Trichina*-infected herds and determine risk factors and intervention points to reduce/eliminate spread and break cycle transmission.
4. Conduct on-farm epidemiologic risk factor study to define the role of cats and rodents in transmission of *Toxoplasma.*

UNIVERSITIES

Two major multistate consortia are committed to reducing zoonotic foodborne agents in beef cattle. As shown below, the Food Animal Production Medicine consortium clearly addresses the preslaughter component whereas the CSREES-supported tristate Food Safety Consortium is directed primarily to post slaughter concerns. For each consortium, the coordinator and the member universities are shown below.

Food Animal Production Medicine
Dr. Fred Troutt, Coordinator (217-333-5310)
Kansas State University
Michigan State University
University of California, Davis
University of Florida
University of Illinois
University of Kansas
University of Nebraska-Lincoln

Food Safety Consortium
Dr. L. B. Daniels, Coordinator (501-575-4773)
Iowa State University
Kansas State University
University of Arkansas

Additional USDA-CSREES funded projects addressing pathogen reduction in cattle prior to slaughter are on-going in a number of university laboratories including Kansas State University, Michigan State University, Ohio State University, University of Georgia, and Washington State University.

GOVERNMENT, UNIVERSITIES, AND PRIVATE INDUSTRY

The diversified efforts of government, academia and industry are summarized in Table 9, entitled Investment Portfolio: Beef Asset Allocation in the Three Institutional Sectors. This is an initial attempt, based on USDA-Research Management Information Services (RMIS) data, to illustrate how each sector--government, universities, and private industry-- is contributing to the total food safety mosaic by addressing such diverse topics

recommended by TAG as Prevalence Studies, Diagnostic Tests, and HACCP Intervention Strategies. The profits realized from cooperative interaction between the three sectors are exemplified by the research summary for *E. coli* O157:H7, which was provided by Washington State University (Table 10). In 1991, Washington State University, the University of Washington, USDA:APHIS:VS and others began a series of studies with the goals of understanding the epidemiology of *E. coli* O157:H7 and determining possible pre-harvest interventions. The information summarized in Table 10 is the result of "strategically linking multiple studies, including several state and federal agencies." For additional information, contact Dr. Dale Hancock (509-334-0711) or Dr. Tom Besser (509-335-6075).

Prevalence Studies are being conducted by government agencies in cooperation with academia. The APHIS Cattle on Feed Evaluation (COFE), surveyed 100 feedlots of the 13 major cattle feeding states for *Salmonella* and *E. coli* O157:H7. The cooperation of APHIS-National Veterinary Services Laboratory and ARS-National Animal Disease Center (NADC) resulted in an estimate of the national feedlot *Salmonella* prevalence of approximately 5.5%. The data indicated that more cattle become infected with, or shed *Salmonella* as animals are housed together over time. The prevalence of *E. coli* O157:H7 in that study was 2.41%, as determined by APHIS-National Veterinary Services Laboratory and Washington State University. The APHIS National Dairy Heifer Evaluation Project sampled 6,894 calves in 1,068 herds in 28 states for *E. coli* O157:H7. ARS-NADC scientists utilized DNA probes specific for SLT-I and SLT-II to characterize *E. coli* O157:H7 strains recovered during that APHIS survey as well as for other FSIS studies. The Tristate *E. coli* O157:H7 project, with APHIS veterinarians from Oregon, Washington, Idaho and Washington State University, is currently evaluating the association of risk factors, such as use of manure slurry on pastures grazed by heifers and ionophore feed supplementation, on dairy herd *E. coli* O157:H7 status. The University of Georgia is also participating in follow-up studies. Food safety is a global issue. The prevalence of verotoxigenic *E. coli,* including O157:H7 in Alberta feed lot cattle, is also under study by investigators at Agriculture Canada, Food Production and Inspection Branch. More rapid verification methods to be used in the plant are also under development by Agriculture Canada researchers.

In the area of **Ecology and Epidemiology**, investigators at Washington State University are establishing the dose of *E. coli* O157:H7 needed to colonize healthy cattle by water, feed and direct oral inoculation. Farms on which *E. coli* O157:H7 have been identified for at least 3 years will be studied in order to identify reservoirs. Water quality is a major factor influencing the prevalence of *C. jejuni* in dairy cattle and is being examined by both government and academic researchers as a contributing factor in the epidemiology of *E. coli* O157:H7. The occurrence of foodborne pathogens, such as *Salmonella* and *Campylobacter* in cattle, can be seasonal. The seasonality of *E. coli* O157:H7 is likewise being evaluated by researchers in government and academic laboratories, as described in Table 10.

In the area of **Feed Management Practices**, both government and university laboratories have invested in research to determine if interrupted feeding, which occurs during transport and while animals are awaiting slaughter, impacts on the shedding of *E. coli* O157:H7 in cattle. Earlier studies indicated that interrupted feeding influences the shedding of *Salmonella* in livestock. Studies conducted at USDA-ARS-NADC demonstrated that interrupted feeding in some cases augments the fecal shedding of *E. coli* O157:H7 in calves. Researchers at the University of Idaho in collaboration with ARS have extended this observation to the shedding of *E. coli* O157:H7 in sheep. The role of competitive exclusion and feed supplements, such as oligosaccharide and ionophores, in promoting beneficial microbial fermentation in the gut which blocks colonization of foodborne pathogens, has brought the microbial ecologist to the food safety table.

In **Pathogenicity** studies, development of efficacious vaccines requires basic molecular biology to identify bacterial receptors and animal models for vaccine testing. For *E. coli* O157:H7, both ARS-NADC and the Children's Hospital Medical Center, Seattle, Washington, laboratories are focused on identifying host cell receptors and the bacterial adhesions. At the University of Georgia, the suitability of outer membrane proteins as

vaccines is being tested in tissue culture with later challenge studies planned in calves and chicks. Investigators at South Dakota State University and at USDA-ARS-NADC have demonstrated the susceptibility of gnotobiotic piglets and weaned pigs, respectively, to *E. coli* O157:H7. The site of colonization in pigs, calves and adult cattle is being identified. Shiga-like toxins (SLT) are involved in human HUS and edema disease of swine. ARS-NADC scientists have reported that vaccination with a mutant SLT strain can prevent edema disease in swine. Thus, mutant toxin vaccines may be applicable in preventing HUS in humans.

For **HACCP and Intervention** strategies prior to slaughter, Kansas State University has developed Cattle Guard, a computer software program. Cattle Guard is part of a Total Quality Assurance program for feedlots and can be an important component to preharvest food safety. Records from Cattle Guard provide documentation that cattle and the feedlot environment have been properly maintained.

Non-specific Factors, such as stress associated with transportation and regrouping of cattle, are also being investigated in government and university laboratories. Administration of dexamethasone has increased the shedding of *L. monocytogenes* in lactating dairy cattle. Stress, as modeled by administration of dexamethasone, is also being studied at NADC with regards to the use of a cervical skin test for *M. bovis*. The influence of stress on the fecal shedding of *E. coli* O157:H7 is being evaluated at Michigan State University. The role that other pathogens, such as immunosuppressive viruses or parasites which destroy the gut barrier, play in the transmission of zoonotic foodborne pathogens is unknown.

Improved Diagnostic Tests are under development in all three sectors--federal government, academic and private industry. To illustrate, FDA scientists (Bothell, Washington), have combined immunomagnetic separation and nested PCR to detect one *E. coli* O157:H7 cell in 10 grams of food. Adaptation of a similar rapid fecal detection method for carrier livestock remains is possible. Scientists at the USDA-ARS-MARC in Clay Center, Nebraska, are constructing PCR primers to detect *Salmonella* in feces of carrier cattle. ARS-NADC scientists are adapting multiplex PCR to detect *C. jejuni* and *Listeria monocytogenes* directly from livestock feces. For *E. coli* O157:H7, a rapid agglutination test to identify carrier animals and an ELISA-based assay are under development at the University of Georgia and at USDA-ARS-MARC, respectively. The sensitivity and specificity of each of these assays remains to be determined in field trials utilizing a statistically significant number of test animals. ARS-NADC investigators are designing rapid methods, including PCR-based assays, to detect *M. bovis* in tissues collected at slaughter.

The **Emerging Foodborne Pathogens** category indicates the awareness of all three institutional sectors of the role of non-*O157:H7 E. coli* in hemolytic uremic syndrome (HUS). Waterborne outbreaks of human cryptosporidiosis have drawn public scrutiny to cattle as a source of *Cryptosporidium*. ARS scientists at Beltsville, Maryland, and Ames, Iowa, are pooling their talents to identify sources of environmental

contamination, to remove the parasite from the environment, to develop medication for prevention and treatment, and to prevent infection by immunization. Vaccines for possible cattle use, based on bradyzoite-specific antigens from *Toxoplasma gondii,* are under study at Palo Alto Medical Center.

TABLE 9: THE INVESTMENT PORTFOLIO: BEEF ASSET ALLOCATION IN THE THREE INSTITUTIONAL SECTORS

TOPIC	GOVERNMENT	ACADEMIC	INDUSTRY
Prevalence studies			
Cattle on Feed Evaluation			
E. coli O157:H7	x	x	
Salmonella	x		
Dairy Heifer Survey			
E. coli O157:H7	x	x (follow up)	
Salmonella	x		
Cryptosporidium	x		
Ecology and Epidemiology			
Water	x		
Vectors			
Seasonality	x	x	
Differential Age			
Susceptibility	x	x	
Live Animal Production Practices			
Feed Management Practices			
Feed Withdrawl			
Sheep	x	x	
Cattle, Calves	x		
Feed Additives			
(e.g. Monensin, Iodine)		x	
Competitive Exclusion		x	
Pathogenicity			
Transmission, Source, Vectors, Carriers			
Colonization,(Adhesions O157:H7, Receptors)			
Calves, Cattle	x	x	
Gnotobiotic Swine, Swine	x	x	
Poultry		x	
Differential Virulence			x
HACCP & Intervention Strategies			
Herd Health			
Non-Specific Factors			
Role of other pathogens			
Stress, transportation, regrouping of livestock			
Genetic p			
redisposition			

DNA-Based Fingerprinting			
SLT I, SLT II. EAE Based-Probes, PCR	x	x	x
RFLP, PFGE	x	x	
X			
Diagnostic Tests	x	x	
	x		
Emerging Pathogens			
E. coli O153:H45	x		
Cryptosporidium	x		
Mycobacterium bovis	x	x	

In closing, The Investment Portfolio (Table 9) is not intended to be an exhaustive tabulation of all on-going preslaughter beef cattle food safety research activities in government, academia and in the private industry. Proprietary arrangements in some instances preclude such an all-inclusive summary. It is intended, however, to emphasize that diversification of research efforts and mutual collaboration among the three institutional sectors have realized significant research gains.

TABLE 10:
In 1991, Washington State University, the University of Washington, USDA:APHIS:VS and others began a series of studies with the goals of uncovering the epidemiology of *E. coli* O157:H7 and determining possible pre-harvest interventions. Great effort has been made to strategically link multiple studies, including several state and federal agencies. The following list provides a brief summary of the picture which has thus far emerged from these coordinated research efforts.

- *E. coli* O157:H7 exists—at least intermittently—in a majority of cattle farms, but the intra-herd prevalence is highly variable.
- *E. coli* O157:H7 is distributed across the U.S. in both dairy and beef cattle.
- *E. coli* O157:H7 appears to be a transient in that carriage for longer than three successive monthly samplings has not been detected. In spite of the lack of carriers, however, *E. coli* O157:H7 seems to be able to maintain itself in a herd.
- Young cattle (3-18 months of age) have a higher prevalence of *E. coli* O157:H7 than do either calves or adult cattle. This age group may represent the critical reservoir and thus the target group for control programs, although a non-bovine reservoir has not been ruled out.
- *E. coli* O157:H7 has been found in deer feces on rangeland shared by cattle from which an identical subtype was isolated.
- The ubiquitous distribution, the lack of detectable carrier, and the multiple host species appear to completely rule out an effective control program based on traceback.
- *E. coli* O157:H7 prevalence has been observed to be associated with several herd-level nutritional and environmental variables. If confirmed by targeted studies, such associations could be useful in control programs.

- Prevalence of *E. coli* O157:H7 in cattle appears to be higher in arm months. Environmental proliferation could account for the seasonal increase in *E. coli* O157:H7 and, if so, the variation in intra-herd prevalence suggests the possibility of important environmental modulators.

- Based on molecular subtyping: a) considerable strain diversity among *E. coli* O157:H7 isolates can be detected using PFGE and much diversity exists even within some herds; b) clones of *E. coli* O157:H7 persist in populations of cattle, apparently in the absence of individual carriers; c) intra-regional transmission of *E. coli* O157:H7 may occur in that subtypes indistinguishable by two fingerprinting methods have been founds on herds >400 km apart.

For additional information contact Dale Hancock (509-334-0711) or Tom Besser (509-335-6075).

ACKNOWLEDGMENTS

I especially thank Nick Nickelson, representing the National Cattlemen's Association, for the industry perspective which he so graciously provided. Researchers are encouraged to complete the attached survey requesting project updates and return them to Nick at the National Livestock and Meat Board (FAX 312-467-1672). I thank the following ARS scientists who provided research summaries and suggestions: Carole Bolin, Brad Bosworth, Tom Casey, Danny Laster, Norman Cheville, Bill Cray, Paula Cray, Randall Cutlip, Jim Harp, Evelyn Nystrom, and Tom Walton.

BLUE RIBBON TASK FORCE-ACTIVE RESEARCH
Information Request Form

Please complete this form with information regarding any research being conducted on *E. coli* O157:H7. FAX to National Livestock and Meat Board at 312-467-1672, Attention, Dr. Nickelson. This information will be compiled into a data base.

TITLE:

OBJECTIVE:

PRIMARY INVESTIGATOR:

BEGIN DATE:

PROPOSED END DATE:

FUNDING AMOUNT:

FUNDING SOURCE:

STATUS (%):

SWINE RESEARCH WORKSHOP
MAY 24, 1995
MORNING SESSION

Co-chairs: Dr. Jerry Torrison
Dr. Hank Harris

Staff Coordinator: Dr. Krishna Murthy

Facilitator: Asia R. Elsbree, USDA, APHIS

Dr. Beth Lautner summarized the status of the following funded preharvest research projects: (Funding of these projects has been from USDA, universities, and/or the pork industry.)

1. Pathogenesis, Transmission, and Control of Salmonellosis in Swine
2. Prevalence Studies of Salmonella in Swine
3. Salmonella Carrier Detection at Slaughter
4. Expansion of a HACCP system to include the Pre-harvest Reduction of Swine Carriers of Human Food-borne Pathogen
5. Isolated Weaning Swine Management as an Intervention Strategy for Bacteria of Public Health Significance
6. Epidemiology and Economic Evaluation of HACCP: Cost Benefit Analysis of Salmonella reduction on swine farms
7. Efficacy of Washing on Reduction of Salmonella in Swine Hauling Trailers
8. A Survey of Feed and Feed Components on Midwest Swine Farms - Pilot study
9. Use of PigMON, a Slaughter Monitoring System for Market Swine, to Identify Hazards and On-farm Critical Control Points for Pathogens of Public Health Significance
10. Effect of Emerging Swine Production Systems on the Prevalence of Salmonella and Toxoplasma gondii in Market Age Pigs
11. Production Management System and Pre slaughter Feed Withdrawal Time Effects on the Development of a HACCP System for the Control of Pathogens on Pork
12. Prevalence of Pathogenic Yersinia enterocolitica Positive Swine Herds
13. National Trichinae Research Project
14. Toxoplasmosis
15. Prevalence of Toxoplasma gondii Antibodies in Hogs, Farm Management Practices

15. Prevalence of Toxoplasma gondii Antibodies in Hogs, Farm Management Practices Relationships, and Economic Costs

16. A Field Trial of the Effectiveness of a Feline Toxoplasma Vaccine in Reducing Toxoplasma Exposure for Swine

17. Strategies to Control Swine Parasites Affecting Food Safety

Further information on these projects can be obtained by contacting Dr. Beth Lautner, Vice President of Swine Health and Pork Safety, National Pork Producers Council, P.O. Box 10383, Des Moines, IA 50306.

The swine research workshop group was requested to address the following topics:

Topic 1. Identify current research initiatives, gaps in scientific knowledge, and research priorities for on-farm, marketing, transport, and pre-slaughter preparation animal production food safety.

The workshop group identified the following gaps in scientific knowledge. (The group recognized that the TAG Report contained a more complete listing of research needs. Please refer to the forum proceedings for May 23, section on AP-TAG Report on Swine for a more thorough review of swine research needs.)

A. TOXOPLASMA:
   1. Verification of prevalence of disease, availability of reliable diagnostic tests and sampling methods for testing. Validation of tests and testing systems are required.
   2 Contribution of pork to the societal cost of human Toxoplasmosis (loss due to human death, sickness and work loss)
   3. Information on swine resistance to Toxoplasmosis through genetics and immune status

B. TRICHINA:
   1. Validation of ELISA test for Trichina
   2. Verification of sampling protocols for Trichina
   3. Contribution of pork to societal cost of human Trichina infection (loss due to human death, sickness and work loss)

C. SALMONELLA:
   1. Information as to what inputs contribute to the introduction and spread of *Salmonella* in pork production systems
   2. Information regarding efficacy and monitoring of cleaning and disinfection.
   3. Information regarding standardization of diagnostic protocols
   4. Information regarding intervention and monitoring strategies for *Salmonella* in swine
   5. Information needed on economic assessment of intervention and disease monitoring strategies for *Salmonella* in swine
   6. Information regarding the point of entry of human Salmonella into the pork chain

D. EMERGING BACTERIA
   1. The workshop group listed *Yersinia, Campylobacter, Listeria* and verotoxin-producing *E. coli* as emerging bacteria. Further information concerning prevalence and pathogenicity identification is needed. Also needed is additional information on the effect of reduction of other pathogens on the prevalence of these emerging bacteria
   2. Information regarding epidemiological investigations but not intervention and pathogen reduction procedures for emerging bacteria at the present time

3. Information on standardization of diagnostic tests for the emerging bacteria

Topic 2: Suggest areas for highest priority research.

The workshop group identified research priorities as Long-term/Ongoing and Short-term. The group did not reach full consensus on the following;

LONG-TERM/ONGOING:

1. The workshop group felt that research is needed on ways to reduce the prevalence of important human pathogens in swine.
2. Research is needed to establish the links between important human pathogens and swine production practices.
3. Research is needed on the practical reduction of Salmonella shedding on the farm.

SHORT-TERM:
Need research on efficacy and economics of swine good management practices for on-farm implementation, e.g. case control study information.

The workshop group also identified criteria for establishing the priority of on- farm research.
The group developed a grid to evaluate for various potential pathogens the societal cost, role of the pig and farm, current knowledge level, potential for payback from reduction/exclusion and the probability of success. Areas with ? indicate gaps needing research attention.

PRIORITIZATION GRID FOR RESEARCH IN SWINE

	Societal				Payback to Industry		
	Cost of Infection	Importance of the pig	Importance of the farm	High Level of knowledge	Cost	Return	Prob. of Success
Toxoplasma	H	H	M	H	?	?	?
Trichina	L	H	H	H	L	H	H
Salmonella	H	M	H	M	?	?	M
Yersinia	L	?	L	L	?	?	
Listeria	H	?	?	L		?	
Campylobacter	H	?	?	L		?	
Verotoxin E. coli	H	?	?	L		?	

Topic 3: Review existing funding from both public and private sources.

The group did not address this topic because of time constraints.

POULTRY RESEARCH WORKSHOP
MAY 24, 1995
MORNING SESSION

Co-Chairs: Dr. Richard Reynnells, USDA, Extension Service
Dr. Stan Bailey, USDA, Agricultural Research Service
Dr. Richard Gast, USDA, Agricultural Research Service

Staff Coordinator: Dr. David Henzler

Facilitator: Julie Marquis, USDA, APHIS

1. Identify current research initiatives, gaps in scientific knowledge, and research priorities for on-farm, marketing, transport, and pre-slaughter preparation animal production food safety.

Dr. Stan Bailey presented a general overview of the sources of transmission for Salmonella (nonSe) and Campylobacter. Dr. Richard Gast presented a serial review of poultry production issues (Se).

2 Suggest areas for highest priority research.

Animal Production

Research regarding microbial physiology of gut microflora
Methods for the identification and monitoring of critical control points
Cost benefit analysis of on farm programs
Practical feasibility study in production
Identification of critical control points
In ovo immunization vaccines
Prevalence studies of human pathogens in animal production
Epidemiology of Campylobacter in broiler flocks
Accurate and simple rapid test for microbes
Studies of the effectiveness of biosecurity to prevent foodborne illness
Verification procedures for on-farm HACCP
The evaluation of the appropriateness of HACCP as opposed to GMP approach
The effect of animal nutrition and diet on human pathogens in poultry
Use of formaldehyde as a disinfectant

Transportation and Storage

Practical ways to decontaminate live haul trucks
Influence of live haul stress on shedding
The effect of feed withdrawal on contamination at packing plant
Effectiveness of refrigeration for the control of Salmonella enteritidis

Interventions in Slaughter Plants

Hygiene training in processing plants
The role of irradiation
Measures of the effect of FSIS inspection procedures on food safety
Preslaughter sanitation dip

Food Handling Interventions

Examination of egg centrifuge machines
The effectiveness of methods to educate people on safe food handling procedures

Traceback

Effective traceback strategies for chickens and eggs
Nonspecific commodity traceback programs
Timely reported incidence of food borne problems
Infectious dose for pathogens in humans

3. Review existing funding from both public and private sources

This issue was not addressed in the research workshop

SUMMARY OF COMMODITY ANIMAL PRODUCTION WORKSHOPS—P.M.

The FSIS Animal Production Food Safety National Forum's May 24 afternoon workshops focused on the same four animal commodity species as the morning workshops on research: dairy beef/veal, beef cattle, swine, and poultry (including egg production). An additional workshop on research funding was added to address the problem of focusing public/private resources during a climate of shrinking research dollars and increasing needs for food safety research.

There were about 40 people with diverse backgrounds in each workshop. Each workshop was chaired by an acknowledged leader in the field of animal production, assisted by a staff coordinator from the Animal Production Food Safety Program, and a workshop facilitator.

As in the morning workshops, each commodity workshop was asked to respond to three questions:

1. Identify roles and responsibilities of various stakeholders from farm to table.

2. Identify partnerships needed for research and education to further implement residue and pathogen risk reduction (prevention) strategies from the farm to the processing plant.

3. Describe potential action plans for the Food Safety Inspection Service, Animal Production Food Safety Program and public/private strategies to support commodity efforts to implement food safety risk reduction practices.

Again, as in the morning workshops on research, common threads emerged as follows:

* Each workshop listed the stakeholders from the farm, through slaughter and processing, to the final consumer as sharing roles and responsibilities.

* Animal agriculture requested a more coordinated and participatory goal-setting research agenda with the regulatory agencies playing the role of process facilitator and coordinator. The Government role should be providing oversight (sharing responsibility with a neutral third party), research coordinating, and facilitating for model projects.

* Risk reduction, not elimination, was the first priority for any focused effort.

* HACCP will not work as a blanket program with producers. HACCP concepts can be a part of a cooperative quality assurance program for live-animal production.

* Regarding partnerships, there was consensus that there is a need to establish relationships with groups that have synergy and to change old established paradigms—new partnerships must be built.

* Potential action plans included:

  The poultry workshop brought forth a resolution that the USAHA play a central coordination role for discussing long-term planning for research and education. The other groups indicated willingness to consider the resolution's merits.

  Short-term planning should start with study and assessment of good production practices (GPPs) already in place and building with those that are found to be effective.

FSIS should develop regional meetings to continue the discussions and coalition building started at this national form.

* Demonstration projects on the farm, with an integrated approach and producer verification of GPPs, could be one of the most effective ways to bring about education and change.

Points in animal production need to be identified and evaluated to determine whether or not HACCP programs are appropriate.

The live-animal production industry believes that, with the science available, pathogens cannot be eliminated at "control points" in live-animal production. What is needed, and what industry is willing to do is to participate in collaborative and cooperative efforts to reduce pathogens and to provide education about appropriate food safety practices. Animal commodity groups do not want mandatory HACCP programs for live animal production.

DAIRY BEEF/VEAL COMMODITY WORKSHOP
MAY 24, 1995
AFTERNOON SESSION

Chairman: Dr. Bennie Osburn, University of California, Davis
(Dean, School of Veterinary Medicine)

Staff Coordinator: Margaret Webb

Facilitator: Mike Tuck, USDA, APHIS

Note--This workshop concerns animals offered for slaughter and does not cover milk production.

Topic 1: Identify roles and responsibilities of stakeholders from farm to table.

It was generally agreed that the roles and responsibilities for stakeholders are shared roles along the continuum from farm to table. The following chart was produced to illustrate which entities or "co-stakeholders" would logically be involved.

STAKEHOLDERS

Stage on continuum	Stakeholder	Co-stakeholders
Farm	Producer	Research, Extension, APHIS, FSIS, FDA, State
	Veterinarian	
Transportation (Activities: QA, HACCP, GPP)	Department of	Transportation, State
Packer/Processor (Activities: GMP, HACCP, Regulations)	Industry	FSIS, Research, State
Distribution	Industry	FSIS, Public Health
Transportation (Activities: GMP, HACCP, Regulations)		DOT, FSIS, FDA, State
Preparer (Activities: GMP, HACCP, Regulations, Education)	Home & Commercial	PHS, Education, State
Consumer (Activities: GFP, Education)	Individual	PHS, Education, State, County

Risk reduction was expressed as the first priority to focus efforts. Calves, bob-veal, formula-fed veal, and non-formula-fed veal should receive heavy focus, along with cull cows (both ambulatory and non-ambulatory). Heifers and milking cows do not need focus at this time.

Source of Hazards: Responsibility:
(----> means "seeks recourse with")

a. Feed	grains and hay	producer/owner--->supplier
	recycled animal protein	owner---------->supplier
	commodity byproducts	owner---------->supplier
	feed supplies	owner---------->supplier
b. Water		not established at workshop
c. Personnel		" " " "
d. Environment/facilities		" " " "

(In addition, what is the role of veterinarians, consultants, others? This needs definition but was not answered at the workshop.)

Workshop participants noted that education of personnel in any risk reduction program is of critical importance. Producers, managers, and critical control managers, etc., all need program education.

Workshop participants agreed that the best way to obtain "buy-in" and to disseminate information is through the use of demonstration farms and extension service networking.

The following points were made concerning HACCP on the farm:

- HACCP will not work as a blanket program with producers.
- HACCP concepts need to be part of a cooperative quality assurance program.
- Any HACCP-type program needs to be closely related to production and quality.
- Producers need to be educated by tying good production practices and TQM to quality assurance programs.
- Use demonstration projects or farms.
- Follow-though by all project personnel is essential in all programs.
- Incentives are very helpful.
- Set up pilot projects on commercial farms, using an integrated approach and producer certification of use of GPP's.
- Consider following model of Empire Sales in New York—a marketing firm that identifies calves (certification) as treated using BPPs. The producer receives quality premium calves, with calves at least 3 days old, and that have received colostrum and have had the navel dipped. Vaccination could also be added to the program.
- Add non-ambulatory animal prevention education to QAPs.
- Add injection site problem prevention to QAPs.
- Set or adopt standards.

The overall goals were defined as:

1. higher quality dairy products
2. reduction of chemical residues
3. reduction of food-borne pathogens in the food chain

Topic 2: **Identify partnerships needed for research and education to further implement residue and pathogen risk reduction (prevention) strategies from the farm to processing plant.**

The workshop group identified the following:

- FDA
- APHIS
- FSIS
- Public Health Service/State Public Health Services/CDC
- Research entities such as universities and USDA's ARS
- Processors
- Transporters
- Brokers
- Extension Services
- Veterinarians (good to disseminate information)
- Food technicians
- Consumers
- State Departments of Agriculture
- Congress
- Press and other media
- AVMA and NOAH
- Industry organizations such as the Animal Health Institute and the Animal Meat Institute

Workshop participants said that the best ways to disseminate information to dairy producers are via veterinarians, demonstration farms, press (particularly lay journalists), farmer meetings, and co-operative meetings.

Participants indicated that reporting of animal disease diagnostic laboratory information should best be done by state-federal cooperation and through use of the DxMonitor. Information should be made available over Internet and World Wide Web. All databases should be broadly available to researchers, both federal and private.

Participants indicated that specific memoranda of understanding are needed between FSIS and APHIS, including state departments of agriculture and other government organizations.

In response to the question of who is to be the lead information organization, the USAHA presented a resolution that a committee appointed by the USAHA president be activated and used as a mechanism through which ongoing dialogue and discussions can be held on the food safety issue. (see Appendix A)

Topic 3: Describe potential action plans for the FSIS, APHIS, APFS Program and public/private strategies to support commodity efforts to implement food safety risk reduction practices.

The workshop recommended that:

1. the USAHA proposed mechanism be used for discussing long-term planning for food safety research and education

2. short-term planning should start with study and assessment of BPPs and build upon this

3. LCI can help disseminate information to producer groups and others. LCI should be encouraged to set up workshops to "train the trainers"

4. new coalitions of organizations and groups with all interested parties, including USAHA, LCI, federal, state, and others be formed for discussion purposes, not consensus purposes

5. FSIS should go to the next level with this Forum and should develop regional meetings to continue the concepts discussed. It is important to gain a groundswell of support by providing better opportunities for producers and veterinarians to provide their input. These meetings could also be used for "train the trainer" purposes

6. AABP, AVMA, and LCI develop QA short courses for training veterinarians

7. all should work together with a Dairy QA Committee and dairy practitioners (AVMA and AABP) to disseminate information

BEEF COMMODITY WORKSHOP
MAY 24, 1995
AFTERNOON SESSION

Chairman: Dr. Leon Russell, Professor of Veterinary Medicine and Immediate Past President, AVMA

Staff Coordinator: Dr. Charlie Stoltenow

Facilitator: Jerrold Gettleman, USDA, FSIS

Topic 1: Identify roles and responsibilities of various stakeholders from farm to table.

The workshop participants identified the following stakeholders:

Consumers
Government
Processors
Academia/Research Community
Live Animal Producers
Input providers/suppliers
Live animal marketing

Roles and responsibilities were defined as follows:

Consumers: Become educated on basic issues of agriculture, demand product standards (quality), educate (information sharing), approval and improvement of standards

Government: Oversight-ensure safe product-HACCP (shared responsibility with neutral third-party), perform field studies and basic research, investigate outbreaks (public health), enforce regulations, establish or demonstrate credibility, advocate public interests, provide funding for research

Academia/Research Community: Provide brainpower to conduct research, plan and conduct basic research, train professionals, set standards for research, conduct extension and outreach programs, work with producer, publish research promptly, identify preharvest critical control points

Producers: Produce healthy livestock, produce safe and wholesome foods, adopt sound scientifically proven policies, provide appropriate environment, make a profit, follow GMPs, identify individual animals

Input Providers/Suppliers: Provide feed, drugs, ingredients, stay within the law to avoid residues and other contaminants, provide related services (engineers, nutritionists, consultants), facilitate technology transfer and education

Marketing: Provide a competitive process and product, maintain reasonable effective sanitation and health standards, minimize stress and contamination in handling and transport of live animals

Topic 2: Identify partnerships needed for research and education to further implement residue and pathogen risk reduction (prevention) strategies from the farm to the processing plant.

The workshop participants did not report on this specific question.

Topic 3: Describe potential action plans for the FSIS, APFS Program as well as public/private strategies to support commodity efforts to implement food safety risk reduction practices.

The beef commodity workshop participants identified the following as actions for FSIS/APFS and public/private entities:

* Identify pre-harvest CCP's and determine if HACCP is appropriate.
* Conduct research to identify these points, the monitoring procedures, and corrective actions.
* Provide money to conduct and promote clinical research and longitudinal studies.
* Develop HACCP models on which to base specific HACCP plans and programs.
* Develop educational strategies for applied food safety.
* Conduct collaborative efforts to educate the public in safe food handling.
* Educate producers on GMPs in production and transportation of food animals (livestock).
* Promote and facilitate teamwork.
* FSIS should create a new image other than regulatory, clearly and honestly. FSIS should be a "facilitator" not a "regulator" of pre-harvest food safety.
* FSIS should validate or facilitate validation of HACCP in animal production.
* Industry needs to determine the differences and similarities between HACCP and quality assurance programs.
* FSIS should work with people rather than against them on tracebacks. Tracebacks should be used for educational and scientific purposes.
* Provide research/education assistance to effective quality assurance programs.
* Encourage research on consumer attitudes toward irradiation, nationally and internationally.
* Establish working groups to identify potential problems and solutions to these problems.
* Facilitate standardization of microbial and diagnostic techniques.
* Facilitate action plans by involving more producer groups through regional and national workshops on pre-harvest food safety.
* Promote a national forum workshop at the U.S. Animal Health Association annual meeting.

SWINE COMMODITY WORKSHOP
MAY 24, 1995
AFTERNOON SESSION

Chairman: Dr. James McKean, Extension Veterinary Medicine, Iowa State University

Staff Coordinator: Dr. Krishna Murthy

Facilitator: Asia R. Eslbree, USDA, APHIS

Topic 1: Identify roles and responsibilities of various stakeholders from farm to table.

The workshop group agreed that research and education is a shared responsibility. Everyone has a stake and a role in it. The partnership approach is mutually beneficial. The partnership team is government, processors, producers, and consumers.

For **Trichina**—
Packers should play the role of verifier. They need to know the trichina status of the pig to effectively identify "trichina free" products. **Producer groups** can lead in education on new technology and the importance of trichina to domestic and international sales. **Producers** must implement known technology and appropriate HACCP procedures for trichina control. **ARS** develops tests, verifies procedures, and works with **APHIS** to transfer technology via field testing. **Practitioners** have a lead role in education, technology transfer and verification of production processes. Controversy exists concerning whether **government or private industry** should lead in "trichina-free" certification for external markets. Third-party verification is needed for credibility of process\product.

For **Toxoplasmosis**—
Presently, the **packer/processor** role is hard to envision. Many roles will be the same as for trichina, except goal definition may be different. Public health data from **FDA and CDC** will help to define what food safety issues need to be addressed. Natural prevalence data and research work to identify HACCP steps are needed.

For **Salmonella**—
Packers/processors, using HACCP, will identify control point procedures and implement those necessary to reduce pathogen entry. The products' **customers** (McDonalds, Wendy's etc.) will demand certain specifications. **Researchers** need to provide tests to help identify pathogens. (Little information exists on whether there is any benefit in packers testing animals for low Salmonella counts as a gatekeeper function.) The role for **researchers and government** is to determine what serotypes are causing disease and developing tests to differentiate. **Veterinarians** have the role of technology transfer of HACCP information. **Producers** will be responsible for identifying what applied research is needed and articulating those needs to researchers and government via national and state organizations. **Government** has the role of problem definition regarding which organisms to target, based on public health information. This function may involve a partnership with the production/processing **industry** and others. The **FDA** may have the role of defining which pathogens are involved with human disease. **FDA** also has the role of approving medication and/ or techniques (i.e. irradiation) that may be useful in removing salmonella from feed. **APHIS'** NAHMS and field force can play a role in establishing pathogen prevalence in livestock populations, education, and implementing field-based research projects. We are not yet at the point where there is enough information available to be used and applied at the **production** level. **Accredited veterinarians** will be useful in technology transfer and farm-specific programs development as research and experience become known.

For **other emerging human pathogens—**
We have a model for addressing pathogens, but we are in the early stages of gathering information for many pathogens. We need to spend more time in learning about the pathogens, identifying them and implementing research projects to determine their ecology and epidemiology in animal populations. As we study the effects of certain management techniques on a specific pathogen, we should concurrently look at the effect of the technique on a cadre of pathogens. A given technique may or may not affect each pathogen the same way.

Topic 2: **Identify partnerships needed for research and education to further implement residue and pathogen reduction (prevention) strategies from the farm to the processing** plant.

The group identified the following partnerships and strategies:

A. For residues, ARS, FDA, EPA, FSIS, universities, producers, practitioners, extension services and states can work together to address contaminants like aflatoxins and dioxins.

B. Establish new relationships between groups that have synergy. Change the old established paradigms.

C. Stakeholders need to function together more proactively across functional lines to identify issues and solve them as a team.

D. Old adversaries need to become new partners to solve existing problems and identify emerging ones.

E. The National Trichina Project is a good example of a proactive partnership. It was formed between ARS, FSIS, APHIS, and NPPC.

F. Animal agriculture wants more coordinated, participatory goal setting, with the regulatory agencies playing the role of process facilitator and coordinator.

G. Partnerships will be easier (or harder) to define, depending on whether APFS programs are based on pathogen reduction or elimination. Reduction, not elimination, should be the goal for many pathogens unless effective methods can be developed to support elimination.

H. Veterinarians will be a key element in better technology transfer to the producer, and can certify farm-based HACCP program development and implementation.

I. A partnership is needed between agriculture production and consumers. Start working with credible groups—those that have their fingers on the pulse of consumer concerns and interests. A grass-roots approach to food safety problems is needed, with a partnership approach using collaborative decision-making.

J. FSIS should not determine how issues should be addressed. Rather, FSIS should pull together the appropriate players with the expertise to develop solutions to APFS issues. The primary government role should be "facilitation", not "regulation" of pathogens unless scientific-based methods which are effective at field levels can be developed. More work is necessary to delineate producer and processor control steps.

K. Building the pork quality assurance program is an effective role for industry to address pork industry problems. This could be built upon to address food safety problems.

L. Organizations such as LCI can play a critical role in the acquisition and dissemination of APFS technology information to the diversity of players across different commodity groups and in development and implementation of national programs for pathogen reduction.

Topic 3: Describe potential action plans for the Food Safety Inspection Service, Animal Production Food Safety Program and public/private strategies to support commodity efforts to implement food safety risk reduction practices.

(The group did not have time to address this issue. See answers to topics 1 and 2.)

POULTRY COMMODITY WORKSHOP
MAY 24, 1995
AFTERNOON SESSION

Chair: Dr. Richard McCapes
Dr. G. Thomas Holder
Mr. Allan Wenger

Staff Coordinator: Dr. Allan Hogue

Facilitator: Julie Marquis, USDA, APHIS

The workshop was divided into three sub-work groups chaired by Dr. Richard McCapes, Dr. Tom Holder, and Mr. Al Menger.

The poultry workshop submitted a resolution (Appendix A) which was adopted by the poultry, beef, and dairy/beef/veal workshop groups.

Task 1: Identify roles and responsibilities of various stakeholders from farm to table.

The discussion started with a description of APFS's role to date. APFS is the FSIS unit charged with promoting voluntary animal production food safety initiatives. FSIS believes that the food safety problem must be attacked at all levels of the farm-to-table continuum. Resources and how to use them most effectively will be an important consideration in the future.

The attendees felt that there is a need for ROLE DEFINITION. Is the government trying to make inroads on how the industry does business? Also, there is a need for a long term COMMITMENT from the FSIS supported by effective COORDINATION AND COMMUNICATION between all the various government agencies.

It was felt that RESEARCH should be a primary role of government and that pathogen reduction programs must be based on research.

It was stated that the FSIS Strategic Plan shouldn't include the term HACCP; the term GMP (good management practices) and not HACCP should be used in animal production food safety. GMPs are more applicable on the farms according to industry people. HACCP has ways to measure and take action but GMPS may also have necessary measurements and monitoring processes. With GMPs, the commodity groups decide on practices, while HACCP is a public measurement system (a process control method). If you set critical limits (such as in a HACCP program) you need to be able to change what you do. If a producer is out of compliance at the animal production level, unlike in the processing arena, he often can't change things immediately to be in compliance.

The broiler industry felt that they should develop their own GMP programs, use new and existing guidelines. It was felt that one (primary) role of FSIS is as a FACILITATOR and COORDINATOR of food safety seminars and meetings. There is a need for SELF DISCIPLINE, especially in the broiler industry. The National Broiler Council and other trade associations would act as coordinators for GMPs.

In the egg laying industry it was felt that everyone has GMPs. Now there is a need to have critical points that are verified (verification is wanted by the customer). Some see a role for FSIS in THIRD PARTY MONITORING.

However, no consensus was reached on the role of FSIS in the verification process. Should GMPs be the interim phase until CCPs are identified?

Others in the audience felt that if you don't have HACCP at the farm, FSIS won't be able to implement HACCP at the processing plant.

Most were against any regulatory activity in the animal production segment of FSIS's food safety program.

There was a discussion about whether there is a role for tracebacks and diversion of product. Without regulation, perhaps industry would be more willing to perform microbial testing. There was some discussion about the possible incentive value of a traceback program.

There was a question about the use of Memoranda of Understanding (MOUs) between FSIS and industries, with FSIS monitoring, but the industry doing the program. It was felt that the legal system won't allow this to work (due to FOIA). Such MOUs would allow free access to information.

A questionnaire was answered by the participants to help define FSIS/APFS's role in animal production food safety. The participants had consensus in the role of FSIS/APFS in identifying risks, identifying and promoting research and cost benefit analyses, and in communication. There was also consensus that FSIS should not have a regulatory role. There was no consensus on other roles which FSIS/APFS might have.

Task 2: Identify partnerships needed for research and education to further implement residue and pathogen risk reduction (prevention) strategies from the farm to the processing plant.

Partnerships identified included government agencies—state and federal—industry, universities, media, and the consumer. Partnerships also should include retail people, private veterinarians, transporters (live bird, egg), and independent (small) producers. Participants agreed that partnerships we already have in the research community must be maintained. It was stated that a partnership with the feed industry should also be developed.

All partners have a responsibility and SHARED RISKS. Partnership PRIORITIES must be similar, with no hidden agendas.

Task 3: Describe potential action plans for the Food Safety Inspection Service, Animal Production Food Safety Program and public/private strategies to support commodity efforts to implement food safety risk.

This workshop did not specifically address this issue.

SUMMARY OF THE RESEARCH FUNDING WORKSHOP—P.M.

The Research Funding Workshop, chaired by Dr. Jerry Gillespie, reiterated that food safety is a **shared** public health issue, and that it is prudent to gain input from all stakeholders when setting research priorities. In addition, there needs to be an effort to find win-win situations for competing for research dollars. The workshop report suggests changing the peer review process and the screening/evaluating process for awarding government research grants to maximize high-quality, timely research. Real changes are needed to make real progress in food safety.

The first point of agreement was that research funding was limited. With downsizing of corporate America, there are fewer research dollars from private sources, and federal research is not growing at a rate to keep pace with research needs. This has led to very keen competition for available research money.

The second point of agreement is that funds from federal sources are directed primarily toward basic research, and those from industrial sources go to research which will yield near-term economic returns. Mission-directed research should include both basic and applied aspects.

A third point of agreement was that we must aspire to support and/or produce high-quality research whether it is basic, applied or integrative. There was consensus for open competition and peer review of research applications.

The group was particularly concerned with the bias against applied research. Open competition and research grant review is in conflict with agency control, with inter-departmental or agency funding and with a centrally controlled distribution of research funds.

Long-term, sustained research is often in conflict with changing research needs.

There was strong support for the formation of partnerships, collaborative groups and consortia to accomplish needed food safety research. The group felt that there should be an avenue for funding of these groups by competitive review mechanisms.

The group expressed support for the research partnerships between industry, governmental agencies and academic institutions. These teams should combine the sort of talent which would lead to high-quality research.

There was support for block grants that were awarded on a competitive basis and that had periodic scientific reviews.

The system needs to change to serve the public.

It was the view of this group that animal production food safety research will not be adequately funded under the current system of USDA agency research reviews.

It is prudent to gain input from all "shareholders" in the food industry and from consumers when setting priorities for food safety research. The group assessed some models, including the current status quo. Our conclusion was that there is a need for change in the way research is currently funded and reviewed if we are to improve food safety.

A second model would be to gather the "shareholders" together to work toward a consensus on what the food safety research priorities should be—a shared vision. It was suggested that shareholders should bring both ideas and resources to the table. It was envisioned that industry representatives, government officials/scientists, academic researchers, health officials and consumers should all be prepared to invest in food safety research.

RESEARCH FUNDING WORKSHOP
MAY 24, 1995
AFTERNOON SESSION

Chairman: Dr. Jerry Gillespie
Kansas State University

Facilitator: Penny Kriesch, USDA, APHIS

Our responsibilities in this workshop were to (1) identify ways to obtain adequate funding of high-quality research in the area of food safety, particularly in the area of animal production or pre-harvest area, and (2) propose practical options for bringing about that funding.

The workshop first identified research matters upon which we agreed. The first point of agreement was that research funding was limited. With downsizing of corporate America, there are fewer research dollars from private sources, and federal research is not growing at a rate to keep pace with research needs. This has led to very keen competition for available research money. This translates into intense competition between government laboratories and agencies, private laboratories and academia. The group took note of the substantial reorganization and downsizing going on in industry and within universities which is thought to have made these institutions "leaner" and more competitive. Is the same occurring in the government research sector?

The second point of agreement which specifically affects animal production food safety research is the bias toward specific types of research by funding agencies. Funds from federal sources are directed primarily toward basic research, and those from industrial sources go to research which will yield near-term economic returns.

A third point of agreement was that we must aspire to support and/or produce high-quality research whether it is basic, applied or integrative. There was consensus that high-quality research was most likely to occur if there is open competition and peer review of research applications.

There was concern that some review panels were biased toward particular lines of research, and that too often this bias is introduced at the time the review panels are appointed. The group was particularly concerned with the bias against applied research. This bias severely limits funding for research needed to develop new practices and technologies which will improve food safety from the farm to the fork.

The group recognized some paradoxes. Federal agency initiatives to address priority research within USDA limit competition and research grant review, but lead to perceived efficiencies. Research that is initiated without review may speed the research process but may also lead to poor quality research. Open competition and research grant review is in conflict with agency control, with inter-departmental, agency funding and with a centrally controlled distribution of research funds.

Long-term, sustained research is often in conflict with changing research needs. For example, long-term block grants, program funding over several years, investment in governmental laboratories, formula driven research allocations, regional research programs may have merit, but also are seen as having a great resistance to change in direction or to downsizing. Changing the direction of a research program (agenda) causes disruption, may break up successful research teams and introduces another form of inefficiency in the research enterprise. Changes may also increase the time required to obtain research results.

These points of agreement provided the framework for the discussion of the group which had representatives from USDA agencies, federal laboratories, academic institutions, and industry. There was a healthy "give and take" in a candid discussion of animal agriculture research.

There was strong support for the formation of partnerships, collaborative groups and consortia to accomplish needed food safety research. The group felt that there should be an avenue for funding of these groups by competitive review mechanisms. There is concern that the current review panels or internal-USDA funding methods prevent funding for extramural (outside USDA) research-consortia. There was general agreement that consortia should remain flexible in order to form new networks which would meet the needs of new research priorities.

The group expressed support for the research partnerships between industry, governmental agencies and academic institutions. These teams should combine the sort of talent which would lead to high-quality research.

There was support for block grants that were awarded on a competitive basis and that had periodic scientific reviews. All federally funded research activity within and outside the government laboratories should have regular outcome assessment reviews.

The group discussed the tension between basic and applied research. There was agreement that both were important; both should be of high quality. Mission-directed research should include both basic and applied aspects. For example, high-quality food safety research, both basic and applied, should be funded without particular bias toward basic or applied, but instead, with a bias toward quality.

The group agreed that there is a broad, public consensus that there needs to be improvement in food safety. This is coupled with a consensus in the food industry that improvement should be science-based and research is needed to improve the technology and practices from farm to fork. It was the view of this group that animal production food safety research will not be adequately funded under the current system of USDA agency research reviews. The system needs to change to serve the public.

It is prudent to gain input from all "shareholders" in the food industry and from consumers when setting priorities for food safety research. Food borne diseases are not a production agriculture problem alone—they affect many constituents. This broad constituency needs to learn how important research is to improving food safety.

Food borne illness is a public health issue. Government agencies, universities, Congress, the public health agencies, primary health providers, and consumers all have an interest in a safe food supply. There are clearly areas of agreement across these groups, and their shared concern for food safety can be a force to drive the political process to improve food safety research funding. There was the view that research resources could be used more wisely. This may come about with increased scrutiny of some government-funded projects.

There needs to be an effort to find cooperative, win-win situations for federal, private and university research facilities as we design food safety research projects. Further, these laboratories should be able to compete for National Research Initiative funds for applied research on an equal footing with basic research proposals.

The group reviewed issues that are important to the food industry. Food producers generally want to be responsible citizens, and they want to produce a high-quality, safe product. Increasingly, producers will need to meet higher standards to compete in the international market or in some niche markets. It is likely that healthy animals will be more profitable and will produce higher-quality food products than sick or debilitated animals. Practices that sustain healthy animals will also support and improve food safety. There is a perception that food that is healthy and wholesome and produced in well managed units will have "added value" and will bring higher

prices. Increasingly, it is being recognized that microorganisms are evolving that will challenge producers to find new technologies to limit food borne diseases. These new technologies will come from animal production food safety research.

The group assessed some models, including the current one—status quo. Our conclusion was that there is a need for change in the way research is currently funded and reviewed if we are to improve food safety.

A second model would be to gather the "shareholders" together to work toward a consensus on what the food safety research priorities should be--a shared vision. It was suggested that shareholders should bring both ideas and resources to the table. It was envisioned that industry representatives, government officials/scientists, academic researchers, health officials and consumers should all be prepared to invest in food safety research.

There is reason to think that representatives from the food-producing industries (including, but not exclusively, the commodity groups) might lead the shareholders to a shared vision for food safety research strategy.

DAY 3
May 25, 1995

FARM TO TABLE
STAKEHOLDERS' PERSPECTIVES

SUMMARY OF STAKEHOLDER'S PERSPECTIVES

CONSUMER

Interventions (controls) have the most profound effect at the root of the tree, at animal production level.

Must keep animals clean prior to slaughter and carcasses sanitized post-slaughter.

Government agencies doing research must better coordinate efforts in animal production (e.g., AB-DEFT, Antibody Direct Epifluroescent Filter Technique).

Need accurate diagnostic tests to find animals shedding pathogens pre-slaughter and send those positive to processed meat.

Need on-going seasonal and regional animal population surveys to define point-in-time empirical data to structure effective long-term animal production intervention strategies.

Need to know the relationship of the proposed Salmonella indicator organism to *E. coli* O157:H7 and other pathogens in animals and build that knowledge into the emerging HACCP system.

Find out multiple pathogens' ecological relationship in single animals.

LARGE PACKER

Must document Good Manufacturing Practices, bio-security, standard operating procedures for grow-out farms, live haul, feed mills, hatcheries, plants and their relationship to pathogen shedding.

Need proven data to directly link rodent control to human food borne illnesses.
Need quick and sensitive tests for pathogens.

What are the impacts of changing procedures on micro-organisms and their prevalence from production to marketing and on the incidence of food borne illness?

What are the best cleaning and disinfection programs that will affect incidence of food borne illness?

Practical and economically feasible changes for HACCP programs.

SMALL PROCESSOR

Willing to take upon themselves the cost of animal identification

Would like to use ID to help gather information and correlate it about the causes of these pathogens and ways to control them

We must look at the overall picture and be open to new ideas and paradigms as they come forword.

LARGE PROCESSING PLANT

We need to focus on the 77% cause of food safety problems: food service.

Information about epidemiology, incidence and causes of pathogens must be rolled into Good Management Practices (GMP).

Preharvest research should be spent on the identification of carriers of pathogens and production practices which prevent their spread.

We need rapid diagnostic tests.

STATE VETERINARIANS

MOUs with States and FSIS are needed for preharvest programs.

Utilize local expertise. Local experience is more cost effective and a better approach than using federal agents to work in the States with producers.

State laboratories should be utilized and supported where needed.

FDA tissue residue program is a model for FSIS to consider in other preharvest activities in States.

State veterinarians should do public health investigations on the farm and deliver educational and prevention information.

Each State must be approached individually regarding its expertise, manpower, and lab services that could be utilized without compensation for extra duties in animal production food safety.

USAHA can provide FSIS a science-based problem-solving national forum where issues on animal production food safety can be discussed, consensus reached, and decisions made that will ultimately influence the safety of the nation's food supply.

ANIMAL MARKET AND DEALERS

Devise food safety programs or controls that make sense for all sectors of the industry.

Don't establish regulatory or programmatic barriers to any particular industry sector's economic health.

VETERINARY PRACTITIONER (FEEDLOT)

Food safety programs must be industry-driven and focused on food safety.

Education and training are key to address day-to-day management practices that influence safety, quality and wholesomeness.

Beef QAP is focused on the consumer, not animal health.

99% of feedlots over 1,000 head work with a veterinarian and 83% have changed animal health practices in the past 5 years based on Beef QAP of food safety assurance.

Zero fecal tolerance on carcasses is not science-based policy.

We need scientific evidence, not speculation, for all food safety policies before something is enacted.

Many people don't trust FSIS because it has always been regulatory in its approach.

SWINE

Mandatory HACCP systems for meat and poultry plants are appropriate.

We do not have the scientific data on preharvest interventions to enhance food safety or to guide implementation of mandatory HACCP of production practices.

We need more information about the ecology and epidemiology of public health significant pathogens in animals before it can be determined where in the food chain is most appropriate for intervention.

Research is needed before on-farm control strategies are recommended.

Can changes in animal production translate to food safety throughout the chain?

On-farm food safety programs will be possible for pathogens only if we focus on reducing or minimizing the risk of food-borne exposure rather than on elimination of the agent.

Because the most common food-borne agents produce little or no disease in animals, strategies developed for minimizing disease and production losses in animals will have only a limited impact on human exposure to these pathogens.

Long-term commitment to ecology and epidemiology research is needed from federal agencies, industry and researchers.

It is important to use pilot projects to determine the effectiveness of model on-farm food safety programs and their cost/benefit.

Food safety programs will need to be different in various regions and types of production systems.

It is the responsibility of industry to develop, implement and maintain effective food safety assurance systems.

We cannot rely on inspection alone.

Government must play a key role to help develop the research agenda for pathogen reduction at the farm level and stimulate public investment in this research.

Government must facilitate technology transfer of research to the industry.

FSIS must cooperate with other agencies to monitor and survey existing and emerging human health hazards associated with animal production.

As research information becomes available, the livestock QAP will deliver the recommendations to the producers.

Without tools to offer a producer to improve food safety, it is not feasible to restrict animal movement nor take punitive action. Trace-backs instead should be used as an opportunity to learn more about the pathogen. The farm could be enrolled in a long-term research program.

Priority food safety areas for NPPC funding:

Identification and elimination of the potential impact of microbiological and parasitic on-farm hazards that can pose a risk to public health.

Identification of critical control points to prevent, eliminate, control or reduce on-farm hazards and various pig management systems.

Effective withdrawal prior to slaughter of fecal contamination of swine carcasses.

Identification of the relationship between the prevalence of pathogens in swine herds and carcasses.

Implementation at the farm should only occur when it's been clearly demonstrated that it translates to enhanced food safety for the consumer.

Incentives for producers would improve cooperation between government agencies and producers.

EGG

Producers should be invited to meetings like this one.

The egg industry has a long history of cooperating with regulatory officials on the SE control programs.

We need refrigeration legislation passed and implemented quickly.

Different geographic regions have different risks and therefore need different levels of QAPs for producers.

A HACCP educational program with and for the industry needs to be developed, including seminars, industry presentations, HACCP school maybe.

Continue research on SE.

The egg product inspection program is a successful food safety model.

Egg trace-back is unfair and unproductive.

FSIS should support UEPs Five Star TQA program as a universal program available to the industry, provide technical assistance when called upon, verification, certification, support the certification of food handlers for restaurants, hospitals and other food service institutions, develop reasonable, balanced and coordinated media release and responses, and work with CDC and FDA to develop and carry out a responsible education program on food handling and preparation.

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POULTRY MEAT

Processing plants cannot be expected to remove all bacteria from the skin of poultry because poultry exists in close contact with excreta.

Environmental concerns are great for using disinfectants.

Bio-security will be a necessary component for producing pathogen-free poultry, and a continuing education program for producers is needed.

Because of the relative numbers of slaughter plants (190) to production facilities (28,000 broiler farms), the most feasible approach to the improvement of the microbiological quality is in the slaughter plant.

We need more research on how we can grow pathogen-free broilers.

There is concern that any production food safety program could evolve from guidelines to regulations and certain groups could impose their beliefs on the political system.

We need research now, not the program. Research should lead to a food safety program.

Food mishandling is a major component of the food-borne illness problem and could overshadow improvements at the production level.

TURKEY MEAT

Government should establish some epidemiological link between human salmonellosis and the animal production efforts.

HACCP as described by the National Academy of Sciences may not be completely applicable to animal production.

The turkey residue avoidance program is being studied to see if it can be modified to include micro-organisms. It is a management program, not a critical control point, not a HACCP program.

We can't get the same results in a production environment as in a processing plant.

NTF is looking at the USAHA's Salmonella reduction program for information.

We don't need to reinvent the wheel every two to five years.

FSIS should consider using "food safety control point" as the TAG recommended.

Industry and government need to advertise the efforts made in food safety.

An exclusion strategy may be possible in the future.

RESEARCH COMMUNITY

Universities should be full partners in providing the science for improving food safety from farm to consumer.

Need an open competition for research funds and critical review of research proposals to assure the highest quality research is funded.

Basic, applied and integrated research is needed.

Agricultural industry and allied groups must bring funding resources to the table, be a part of the priority setting, and be involved in the critical review process.

This forum should involve all participants in setting research priorities, devising a process for open competition and review of research, and in helping build multi-disciplinary, multi-site research teams.

DAIRY BEEF/VEAL

The more control one has in determining the end point, the more responsibility one bears.

If CDC states that 77% of the problem in food safety is food service, then that is where we need to concentrate efforts.

Producers must implement quality assurance programs and best management practices.

Pilot projects and demonstration farms will give new information to producers. These need to be funded.

Commend the TAG report for recognizing QAPs.

Best management practices and items that affect quality usually bring economic benefit.

Need research in ecology, epidemiology, carrier animals, and shedding in order to make good decisions.

BMPs recommended on incomplete science usually end up losing producers money.

We need to design BMPs and QAPs working back from processors to producers.

QAPs need to be voluntary, flexible for different areas and types of production practices, and be based on scientific knowledge.

We all need to take personal responsibility.

We need to cooperate and not regulate. Cooperation encourages innovation. Regulation stifles change.

We don't have the scientific tools for HACCP now. We need to build on BMPS and QAPs already in place.

Producers can offer insight and help channel government efforts, not change them.

Producers need to be part of the program reviews. They haven't been included as peers.

BEEF CATTLE/FEED LOT

There are about 1 million producers and many are part time.

Pasture cattle shed *E. coli* O157:H7 about the same rate as feed yard cattle.

Proper pen management at feedlots helps reduce foreign body and dirt contamination.

Residue avoidance programs are very successful and they are HACCP type programs.

About 40 states have beef QAPs going on. Beef QAPs are targeted at safety and quality of the product.

NCA has supported $4 million to research *E. coli* O157:H7 from farm to table.
State cattlemen's affiliates have provided research grants to universities in food safety.

The Blue Ribbon Task Force of the Livestock and Meat Board (Note: on which FSIS participates) will continue to fund research on host-pathogen relationships of O157.

We need to identify factors outside the bovine reservoir that contribute to the prevalence of O157, maintenance of contamination, how it survives outside the host, human shedding, and other pathogens.

We need to know how an animal is positive, then reverts to negative shedding.

How do cattle transportation systems contribute to the spread of O157?

We need an industry-driven food safety center clearinghouse to avoid duplication and speed up efforts to find management practices that might reduce the problem.

USAHA is suggested as a clearinghouse or center of information that could represent all of the commodities.

We need more epidemiological studies to help learn the control points, but a significant problem for success is the low incidence rate.

We need standardized methods of sample collection and culturing O157.

The critical control points in animal production are lacking.

Downer cows need to be studied.

We must not promise the public something that we cannot deliver because we will lose consumer confidence and give them a false sense of security.

Animal production practices are not likely to eliminate microbial hazards.

It must be part of an overall program from farmer to consumer.

QUESTIONS TO THE PANEL AND COMMENTS

1. Who verifies commodity QAPs and are there any control requirements?

NPPC: Third level QAP is verified by a veterinarian, extension agent or agricultural education instructor. Over 90% are verified by a practicing veterinarian.

DAIRY: Similar.

BEEF: No official certification- all voluntary, but more and more veterinarians are getting involved.

2. Food Animal Concerns Trust: stated that beef QAP consisted of only a pamphlet and no other help. Pork QAP only has 30% of NPPC members on the Level 3. Only the Pennsylvania Egg QAP requires microbial testing. FACT requests that USDA require that animal health certificates come along with new stock or stock to slaughter that states their Salmonella content. Feed deliveries need this certificate also. This will protect the producer from introducing contamination through stock and feed onto his farm.

3. Center for Science in the Public Interest (Smith-DeWaal): What are the commodity groups doing to educate consumers about safe food handling and preparation beyond what the USDA requires?

Perdue Farms: We had safe handling labels on fresh products before it was required by the USDA. We have educational materials on food safety. We provide them to food service distributors and end-use customers.

NTF: consumer education and public service videos on proper turkey cooking.

CANADA: government and industry work together to educate consumers with generic food safety messages that do not implicate any one commodity. The problem has been how to best distribute the messages and how often to change them to keep peoples' attention. All of these programs must be perceived as adding a safety margin to what is already safe. Canada and the U.S. have the safest food products in the world.

NPPC: Point of sale consumer cooking educational materials, food service and retail educational materials are distributed.

BEEF: Have conducted food safety seminars for retailers.

STOP: Request that everyone take responsibility and provide the consumer with less pathogenic bacteria to handle.

4. What does Safe Tables Our Priority (STOP) recommend to the animal production side?

STOP: Producers and processors must work out how to provide the cleanest animals for slaughter. Research is needed for seasonal patterns of shedding and a lot more epidemiological data before we can talk about any interventions.

BEEF COUNTERPOINT: We do try to have cattle as mud-free as possible prior to slaughter for economic and animal welfare benefits. We do not have the technology to do a better job yet.

BEEF COUNTERPOINT: We do try to have cattle as mud-free as possible prior to slaughter for economic and animal welfare benefits. We do not have the technology to do a better job yet.

5. Explanation of USDA Meat and Poultry Hotline educational efforts.

6. Can the beef industry work with government, public health, academic and others on outbreak investigations to the farm to help study the problem?

BEEF: I hope so. The producer must not be threatened with liability or to be shut down unfairly. Over 70% of the feed yards that volunteered for the NAHMS cattle on feed study were found to be shedding on at least one fecal sample, but less than 1% of the animals on a single feed yard were shedding. There are a lot of questions to be answered before we go witch hunting in the feed yards.

FSIS: does not have the authority to quarantine farms or perform tracebacks to the farm. That is the States' authority.

USAHA: States are willing to help producers and work with federal agencies to gather information.

7. Request to spend more on investigating food borne outbreaks to find out the reasons than for trying to attack the food chain everywhere now.

8. We must not raise consumer expectations at the animal production end because all you need is one vector entering the production farm and contamination results.

SUMMARY COMMENTS FROM MR. TAYLOR, FSIS:

Points in wide agreement:

1. The federal government must not mandate specific on-farm management practices to try to improve food safety. This is in agreement with the FSIS-proposed HACCP pathogen reduction regulations. FSIS is shifting away from mandating any management practices.

   FSIS' regulatory authority is in-plant, but there is a paradigm shift not to mandate detailed management practices. We want to rely less on command and control of what processors need to do to more heavily on performance standards and food safety objectives that plants must be held accountable to achieve.

2. FSIS has an important role in animal production food safety. That is to ensure that opportunities for making progress continue for industry quality assurance programs. Opportunities for progress can be made through research to look for solutions than may exist at the animal production stage.

3. There is a responsibility to address food safety at the animal production stage.

4. The private sector will be the primary source of solutions and will discover optimal opportunities for food safety.

5. Changes will be market-driven and the private sector will have the practical knowledge of what will work and what won't work.

6. Producers have the creative abilities to help us figure out what we can do and to take full advantage of opportunities. Producers must be fully involved.

7. Government does not produce food. Government cannot make food safe. It will be those engaged in the commercial enterprise who will be the primary source of solutions, particularly in animal production food safety.

8. Government's responsibility in animal production food safety is to contribute to help focus research which will lead to the most productive and practical solutions to food safety problems.

   There needs to be recommendations for a process to focus research which will stimulate public/private investment in a prioritized agenda with a reasonable pay-off of practical results.

9. There needs to be more private investment in focused research to address animal production food safety issues.

10. FSIS can foster collaboration among a diverse array of groups. No one group has the answers or bears the only responsibility.

11. FSIS does have a role in fostering implementation of solutions through appropriate means as they are discovered. FSIS will not mandate management practices, but needs to foster collaboration to do it.

QUESTION OF MR. TAYLOR:

Please clarify the FSIS policy of declaring a pathogen an adulterant and how that relates to the live vs the finished product.

Based on our statutory authority, raw ground beef is unhealthful and therefore adulterated if it contains *E. coli O157:H7.* FSIS has not addressed other pathogens, products or animals. Instead, we've proposed in the HACCP pathogen reduction rules to reduce pathogens by using available technologies and focusing on Salmonellae in plants. We have not considered an approach that live animals are adulterated if found to bear a pathogen. I don't know the legal analysis of this and I don't believe this line of inquiry to be particularly fruitful. It's not an approach that we've considered.

TEXT OF MAY 25, 1995
PERSPECTIVE PRESENTATIONS

MS. DONNA ROSENBAUM
SAFE TABLES OUR PRIORITY (STOP)

CONSUMERS

Good morning. I'm Donna Rosenbaum, Executive Director of S.T.O.P.- Safe Tables Our Priority. I would like to thank Dr. Buntain and her staff for giving me the opportunity to speak to you this morning. As I was sitting and wondering on a Monday morning what to tell you about the work we do, I remembered the Monday morning not long ago when S.T.O.P.'s 800 Hotline phone rang and it was a young mother calling long distance from a pediatric intensive care unit. She had already been stationed for five days by a hospital bedside watching her 13 month old son battle Hemolytic Uremic Syndrome (HUS) and kidney failure after contracting an *E. coli 0151:H7* bacterial infection that was most likely caused by an undercooked hamburger he ate. We spent over an hour on the phone. She had many questions and concerns and although her son's doctors were providing excellent care, they really didn't have very much to tell her about interactions needed with their local and state health departments, origins and reason behind the "hamburger disease" epidemic, how contagious it is and how to prevent secondary transmission to other family members, etc.. The doctors wouldn't have had the time to discuss these issues with her even if they did have the answers. You see, they had to move on quickly and start caring for three more children who had just been admitted with the same symptoms and who were now in life-threatening renal failure. This, ladies and gentlemen, was the beginning of an outbreak, one of the 50 additional *E. coli* outbreaks that have happened since Jack in the Box. I became active in safe food issues and helped found S.T.O.P. when my six year old daughter's best friend was the first child to die in the Jack in the Box outbreak.

We receive calls from *E. coli O157:H7* victims and their families at S.T.O.P. on a daily basis. Don't be fooled into thinking that this disease is limited only to children, either. Although the very young and the elderly are most at risk for developing complications from foodborne disease, *0157:H7* illness recently took the lives of a 53 year old woman in Ohio and a 54 year old woman in Washington. A vibrant Alabama college student just sacrificed her freshman year and almost her life to a contaminated hamburger and a Massachusetts insurance executive is in her fourth month of disability following a one month hospital stay with an *E. coli* infection in February of this year. No one is immune from foodborne illness. Although S.T.O.P. was founded by families who had suffered through *E. coli O157:H7* disease, we now hear from victims of a wide variety of foodborne illnesses.

S.T.O.P. provides victims and consumer information on food safety and foodborne illnesses. We give foodborne illness victims a voice in demanding a safer food supply. We provide information and assistance to physicians, the public health community, legislative officials, and the press. We have a policy board and additionally participate in the Safe Food Coalition, which collectively represents groups representing at least 50 million American consumers. S.T.O.P. now has chapters starting in 45 cities nationwide.

S.T.O.P. is non-partisan and flexible. We are willing to talk to anyone and everyone concerning issues that affect public food safety. I invite you to call us up if you would like our opinion. We have a nation full of volunteers who are motivated by nothing other than to prevent others suffering the same fate as their loved one. To understand their motivation, you have only to stand for 1 hour by the bedside of a child suffering *E. coli O157:H7* induced HUS. I have done this many times. Additionally, I have personally spoken to over 300 *E. coli O157:H7* victims families and thousands of consumers about pathogens in our food, and meat and poultry inspection reform.

I would like to share with you S.T.O.P.'s and consumers, concerns and issues in animal production. First of all, I would like to introduce a new conceptual manner of looking at food production. For the longest time we have

heard about our food production chain, with link following link in the chain from farm and animal production to the end of the chain at the consumers table. This linear chain, however, implies equality among the links in a linear progression, with food safety interventions at all points in the chain having equal effect. Instead, we think of food production as a food safety tree where animal production is at the roots of the tree and consumers are the leaves. You cannot control the health of the tree by watering the leaves. You have the most control and the most profound effect with interventions at the roots of the tree. That is why I am excited to be here and participating in animal production food safety dialogues. Just as scientists talk about log kills of pathogens with various post-slaughter interventions, you can exponentially affect the bacterial pathogen load of our meat and poultry products at every level as you proceed backwards down the tree to the roots.

Consumer education on safe food handling is part of the equation, of course. Especially for high risk populations. But, it is certainly not the only nor the most effective way in which to ensure that bacterial pathogens in meat and poultry products don't make people sick. Consumers are told "cook you meat until its thoroughly cooked and brown" and that will solve the problem. But, now we know that *E. coli O157:H7* can survive the sausage and salami making process and be present in a ready to eat product. Current research at Kansas State is showing that even assuring a ground beef product is cooked until brown or gray is an inadequate public health defense mechanism. The age of the beef and its exposure to air seem to be variables that don't permit adequate visual accuracy for pathogen kill. The temperature is the key ingredient and the oxidation process permits some of the meat to appear brown or cooked when it may be as much as 20 degrees below the recommended 155 degrees.

It isn't fair to tell consumers to clean their counter tops when the animals aren't being kept clean. If I clean my counter top diligently I can help reduce risk of foodborne illness for just my family. If the animal production industry would diligently keep animals clean prior to slaughter, they can help reduce the risk of foodborne disease to hundreds or thousands of families. The cleaning and sanitizing of animal carcasses ought to be a mandatory control point in any HACCP system. We will be encouraging FSIS in our comments to make it so. Research in the industry right now should be focused on what treatments and rinses can be effective in getting fecal contamination and pathogens off the hides and skins of all animals before slaughter. Instead, all of the effort seems to be on what rinses and solutions to use after the fecal contamination has spread to the meat. This does not make sense to us. While many types of bacteria may be "inherent" in our food supply, *E. coli O157:H7* is not. The issue should not be how do we control it once unleashed: but how do we prevent it being unleashed from bovine fecal, milk, and ingesta material and spilling into our meat in the first place.

There is a widely held misconception that consumers are against new technology. We are not. But, we do ask for some basic prerequisites and common sense in applying technology. It needs to be based on firm, peer-reviewed scientific process and exhibit efficacy, not wishful thinking. Particularly suspect to consumers is technological research conducted where the results are announced as preliminary findings with only 50-60% of the project completed. Most technological advances of the past few decades have been economically driven. We rapidly produce an abundant and relatively low cost food supply. But at what cost for this high productivity? We believe that, even with HACCP, continuous carcass by carcass federal inspection must continue. But, do we need to look at line speed control so that carcass by carcass and HACCP can work more effectively? I realize this is going to be an unpopular subject in this room, but I wouldn't have a clear conscience if I didn't bring it up. S.T.O.P. and the food safety consumer movement feel that the tremendously increased line speed of the last few decades are directly linked to the increase in pathogen load and human illness.

Consumers don't mind paying a little more for safer meat and poultry products but we won't trade safety for convenience and expediency.

There are additional issues that are important to consumers. We encourage FSIS to have an international outlook and approach in subsequent meetings and research. Over the last few days of our meeting I have tremendously enjoyed and gained much insight and knowledge from talking to participants from other countries. We must be

open-minded and not insular in our approach. It doesn't matter whose idea it is if it decreases pathogens and protects lives.

We are requesting that government agencies doing research better coordinate their communication efforts. While attending the April Chicago Technology Conference, I heard an interesting short presentation by an FDA researcher with a lot of potential for direct and almost immediate applicability in animal production science. Part of the problem in pathogen detection has been the lack of rapid identification tools. This researcher has perfected a technique for quickly detecting *Salmonella* and specific *E. coli O157:H7* that is called Ab-DEFT, or antibody direct epifluorescent filter technique. She can take a bovine fecal sample and without enrichment find fairly low levels of *0157* in a few hours by looking for fluorescence under a regular microscope. She has been working on this since 1989 but other FDA and government researchers have not been aware of her work. If we have a rapid way of finding animals shedding pathogens just prior to slaughter, could we prevent these animals from being used for fresh, raw product and instead send them to be used in processed or rendered product? This seems to be a way to cut down on pathogens loads reaching the consumer. We need better communication of research projects nationally so that we don't waste efforts by duplication or ignorance that a piece of research has already been done.

In our new model of the food safety tree, it has become obvious that the level at which we ultimately should have the greatest control of animal pathogens entering the food supply, animal production, is also the area we know the least about. There are gaping holes in our knowledge of host-pathogen interactions, epidemiology of animal infection and pathogen carriage, and ecological niches.

In developing long-term strategies at the animal production stage, the starting point needs to be developing an ongoing, seasonal and regional survey. Although incidence rates and patterns for certain pathogens are known to a better extent than others, the scarce point-in-time population studies do not provide the empirical data upon which to secure effective long-term animal production interventions.

The Proposed HACCP Rule uses *Salmonella* as an indicator organism, yet we really don't know whether the presence or shedding of *Salmonella* in a particular animal at a particular point in time is linked to the presence of other pathogens, such as *E. coli O157:H7.* The literature quoted in the Appendix to the Proposed Rule seems to suggest that bovine *Salmonella* is more related to animal health whereas *0157:H7* incidence is more prevalent in younger animals and is not related to animal health. This research needs to be started immediately so that proper interventions for all pathogens can be built into emerging HACCP systems. Additionally it's not enough to just say "*Salmonella*", but to differentiate what type of *Salmonella.* It is important to know within one animal what particular types of pathogens present simultaneously as this will clue us in to environmental components of potential interventions.

While long-term animal production solutions are going to require a huge investment of time and resources, it seems necessary to bring up one short-term management intervention that could reap immediate short-term pathogen reduction success. After reading the complete HACCP Proposed Rule and studying the accompanying appendices and flow charts, it appears that the skill of the in-plant evisceration operator in preventing intestinal spillage in to the meat, especially in cattle and swine slaughter, has been overlooked. At the Chicago Technical Conference, I also heard a short presentation by an avant garde pork processor. They set up an almost "Pavlovian" system on the slaughter line where bells at various intervals down the line form evisceration were rung to tell the operator that fecal smears had been found on their carcasses. The best results were recorded on a large board providing in plant competition and pride in producing the fewest fecal problems. This is a simple, inexpensive intervention that has much potential. Additionally, we feel that training evisceration operators so that they understand how critical their function is to safe food (and by the way, training in their own language would also be effective.) This should be a critical control point in all HACCP plants.

In moving to HACCP process controls, it is extremely important to realize that HACCP is not a five letter word with magical powers. There is no "abracadabra" all of a sudden public health is protected. Any control system is only as good an its weakest link and a potential weak link in HACCP is people workers. You can have documents, papers, and plans that tell you what hazards are and what functions to do, but until all employees understand their role in producing a safer product, the papers are meaningless. HACCP is critically dependent on people understanding and caring to do their jobs right. Innovative thinking, training, and empowering employees to do a food job and use common sense, can be more effective and infinitely less costly that looking to new technology for a quick fix. I've told you some of what consumers do want. Now I'd like to tell you what they don't want consumers don't want safe food initiatives to wait, be held up, bartered away, or watered down. Consumers will frown upon industries who don't accept responsibility for giving us the cleanest, safest, product possible. We will never have all the answers. HACCP and pathogen control systems are a dynamic and emerging entity just like the emerging pathogens they target. We have to start somewhere and the time is now-before more foodborne bacterial outbreaks chase away so many consumers that the risk reduction and intervention in the world won't bring them back. At S.T.O.P. we don't tell consumers to avoid product, we teach them to reduce risk. As we sit and wonder when, not if, the next few hotline calls will signal another outbreak, I ask you to do your part in making our phones stop ringing.

BIOGRAPHY

Mrs. Rosenbaum is the National Director and co-founder of S.T.O.P. (Safe Tables Our Priority), a grassroots non-profit organization for the prevention of *E. coli O157:H7* and other foodborne bacterial illnesses. She became involved in safe food issues after her 6-year old daughter's best friend was the first child to die in the Jack in the Box *E. coli* outbreak in San Diego in December of 1992. She received a Bachelor of Arts degree in Neurobiology at Northwestern University. Mrs. Rosenbaum was a research associate for seven years and has worked in health care management for eight years.

DR. JHUNG COLBY
PERDUE FARMS, INC.

Dr. Donna Hill
Dr. Keith Reinhardt
Dr. Jhung Colby

PACKERS

At Perdue Farms, we are accepting our part of the responsibility to assure food safety by doing what we believe to be right. We are in the process of implementing pre-harvest and post-harvest HACCP systems, identifying critical control points, and evaluating potential corrective actions. Our HACCP systems involve the entire complex industry from breeder through processing. Ultimately, our products enter the food service system where they go to the commercial kitchen, the retailer, and the consumer. At Perdue, this involves 12 feed mills, 19 hatcheries, 16 plants, and potentially reaches 260 million people.

Perdue is working with the official/conventional definition of pre-harvest programs which essentially involves documenting good manufacturing or management practices (GMP) and emphasizing standard operating procedures (SOP) on bio-security and sanitation. The major changes occurring with implementation of HACCP are 1) emphasizing programs already in place, the GMPs, 2) increasing awareness and control of rodents, and 3) implementing SOPs in all areas and 4) monitoring critical control points.

We support the concept of pre-harvest and post-harvest food safety by doing what we can with current technology, but we also recognize that there are no proven methods on how to impact the incidence of food-borne illnesses with the current processes. We do not know what the impact of changes in production, slaughter, processing, or distribution procedures will be on the incidence of food-borne illnesses.

For the farm-to-table HACCP approach to be successful, everybody must share the responsibly, including consumers and food handlers. It is a collective effort and no one group is responsible for it.

If the goal of assuring the safety of meat and poultry products from farm-to-table is to be reached, all links in the chain must be present. The major missing link is the quick and accurate assays (rapid, sensitive testing methods for pathogens). Other key elements involve educating consumers, training food service employees, and emphasizing the fact that eliminating all pathogens is not possible. In poultry production, there are cleaning and disinfecting programs, but there is no research to recommend the best method that will affect incidence of food-borne illnesses. Currently, there is no proven way to impact the goal of assuring food safety with present technology.

More research is needed to recommend practical and economically feasible changes, develop testing methods for monitoring and verifying HACCP, and develop training programs for food handlers. Changes must be based upon realistic expectations and regulations with a proven return on food safety. An example of an unrealistic change is "All farms are required to have concrete floors to prevent rodent infestation." There is no proven data to show that concrete floors in farms will prevent rodents. Since these are contracted farms, the cost to farmers would be $12,000 for 40X490 square feet. If we look at the cost to retrofit Perdue Farms with 10,000 houses, it is $120 million, and this is less than 10 percent of the industry. Justification for costs must be valid and have a direct effect on the safety of the final product because increased costs have to be borne by consumers. The public must be educated on what a realistic expectation is. Timely regulatory approvals for improvements for equipment, processes and anti-microbial treatments are also needed.

The focus must be on the risk reward. What is the value for the cost? At Perdue we will continue to meet realistic expectations for pre-harvest and post-harvest programs. Until we have proven preventive methods, we will continue to develop baselines, implement rodent controls, follow good manufacturing/good management procedures/practices, and have standard operating procedures for bio-security and sanitation. Currently the technology is not available to go beyond this point.

BIOGRAPHY

Dr. Jhung Won Colby graduated with a B.S. from Tufts University, obtained her M.S. from the University of Connecticut, received her Ph.D. from the Virginia Polytechnic Institute and State University, and received her Post Doctoral Research Associate training from the Virginia Polytechnic Institute and State University.

Dr. Colby is the Director of Microbiology Research at Perdue Farms in Salisbury, Maryland. She is responsible for directing microbiology research and developing food safety programs to reduce pathogenic microorganisms. Her research is concentrated in areas of live production but she coordinates the efforts at the processing plant and on the finished project.

Dr. Colby is Adjunct Assistant Professor in the Department of Animal and Food Sciences at the University of Delaware.

Dr. Colby has conducted research on pathogenic microorganisms in poultry, meat, and seafood. She has publications including journal articles and book chapters.

MR. DAN MONTANARI
COLEMAN NATURAL MEATS

PROCESSORS

In 1968, who dominated the world of watch-making? It was the nation of Switzerland. They controlled 68 percent of the market and, according to some experts, 80 percent of the profits. They truly dominated the world of watch-making.

Ten years later, however, a dramatic change took place. As a result of this change, 50,000 of their 65,000 watch-making workforce lost their jobs. What change could have caused such unexpected results? How could a nation that was known for its excellence in watch-making suddenly watch its market disappear? What was it that caught the Swiss so much by surprise? It was a paradigm shift.

Today, who dominates the world of watch-making? It is the Japanese. How was it that a country with almost no market share in the watch-making industry could so easily rise to a place of dominance? Why were the Swiss unable to see such a great competitive force rising to challenge their position of dominance? Well, the answer to that question is that the Swiss were put back to zero by a paradigm shift. That paradigm shift is probably on the wrist of most of us today. It is the quartz watch.

To fully appreciate the power of paradigms, one must understand the history of the development of the quartz watch. In fact, the quartz watch was invented by the Swiss themselves. However, when researchers presented this technology to the watch manufacturers, the manufacturers rejected it out of hand. The question remains, why would they reject a technology that was visibly superior to what they had in the part. Well, the problem was that this new watch did not have any gears. It did not have a main spring. It wasn't at all similar to what they had produced in the past. The success of their past lead them to success in the future. They had become blinded by their old paradigm.

This story is not just about watch-making. It's a story for those of us in the meat industry who are unwilling to change our ideas and our perspectives about the way that meat should be produced.

I represent a beef company called Coleman Natural Meats, Coleman raises and markets beef raised without antibiotics or growth-promoting hormones. Our product has given us a niche market in the beef industry. As a result of this niche, we have been able to develop some new approaches to meat production.

These new approaches fall into four distinct categories

1. Sustainable Agriculture
2. HACCP
3. Animal Identification
4. Product Identification

Sustainable Agriculture. Coleman has realized that we must be stewards of the natural resources to which we have been entrusted. As stewards of the land, we are responsible for passing the land that we use on to future generations. We do not see beef production as our sole responsibility.

We are also responsible for the way that we treat the land. We believe in the controlled use of chemicals for correct reasons. We believe in the humane treatment of animals, and we believe in a holistic approach to raising animals. We believe that it is wrong to use medicines for the sake of increased production.

As a result of being a vertically integrated company, we are allowed certain unique opportunities in producing our products. We have a greater degree of control over our product than most other beef producers. We have a group of ranchers under contract that we call Coleman Certified Ranchers. They follow strict guidelines in order to produce cattle that meet our specifications.

HACCP. One of the overriding goals of our business is to produce the highest quality product for our customers that is also safe to eat. We take a pro-active rather than a reactive approach to our production practices. Part of being pro-active is our 27 point HACCP program.

Our HACCP program is different from most other beef producers in that we have a HACCP system that extends from the Farm to Table. At the farm level we test for compliance with our natural guidelines, to ensure that no antibiotics or hormones have ever been administered to our animals. We continue our HACCP program on to the feedlot, the slaughter plant, the processing plant and ultimately to the consumer.

With more and more consumers becoming conscious about the foods that they eat, we have found a receptive audience for our product. Consumers interested in our product tend to be well educated consumers who are concerned about what they eat. As a result of this, we devote a considerable amount of our marketing dollars to consumer education.

We also work closely with our retailers in developing HACCP guidelines. We have created a 14 point HACCP guideline for retailers. Again, taking an extra step to be proactive producers.

We also have 9 control points for the end consumers. Most of these points relate to sanitary practices and proper food storage. The thing that does set us apart is the fact that we are attempting to educate and inform retailers and consumers ourselves, rather than hoping that someone else will take the responsibility.

Animal Identification. One major area where Coleman Natural Meats has taken the lead is in the area of animal identification. We have developed a system to identify each animal under our control. This identification process begins by attaching a bar-coded car clip to each animal. This number is unique for each animal and allows us the ability to monitor and track the source of each animal.

We see animal identification becoming a key component of our HACCP based systems, as well as a means to increase our production efficiency. This project has required considerable investment on our part, but again, we believe that our past successes will not guarantee us a market in the future, unless we take active steps to ensure market leadership.

Product Identification. As a result of concerns caused by the recent outbreak of *E. coli* in the Northwest, we began to wonder what would happen to Coleman Natural Meats if we were suspected of being the source of such an outbreak. As a result, we developed a system that we call "Origen".

Origen is a system that picks up where animal identification leaves off. Origen maintains the unique animal identification number attached to an animal and copies that number through to the resultant meat products produced by the animal. Although this project is not currently being implemented, we have begun to develop something that no one else in the meat industry has done, animal identification from "Farm to Table".

In conclusion, many forces are currently at work that will affect the meat industry for years to come. Among such trends are increased consumer expectations, the transition to a global marketplace and increased concerns for food safety. Remembering the power of paradigms, we have taken a number of proactive approaches to both increase the safety of our product as well as our ability to compete in a changing global marketplace.

BIOGRAPHY

Dan Montanari is the MIS Director for Coleman Natural Meats, Inc. He is the inventor of the Origen Tracking System. Origen is a patent pending method for identifying the production process of a food product. He has also been selected to serve on the Organic Crop Improvement Association (CIA) Standards Committee.

DR. DELL M. ALLEN
EXCEL CORPORATION

PROCESSORS

Excel Corporation slaughters and fabricates cattle in six beef plants in the U.S. and one in Canada and hogs in two U.S. pork plants. We also further process meat products in four further processing plants. We began developing Hazard Analysis Critical Control Point food safety systems in 1991 and currently have fully implemented HACCP plans in all our facilities. We fully endorse utilizing a HACCP based system as a preventative system of improving food safety. We share the concern of some in the food industry that HACCP is being oversold to the public as a system that will ensure a 100% safe food supply.

It is important to realize that using HACCP as a food safety system will not guarantee pathogen free raw products. In order for food to be pathogen free even when produced under a HACCP system, the system must contain a microbial kill step in the production system.

Using current up-to-date technology, the only microbial kill steps that are available are cooking (time/temperature) and/or irradiation. The latter is not currently approved or accepted and the former not utilizable except on product sold in a cooked form. Consequently, until there is a major technological advance, we will still have raw products that contain pathogens.

As HACCP systems are developed and implemented, it should be remembered that according to CDC (Centers for Disease Control) data, 3% of food borne illnesses are attributable to processing plants, 20% to homes and 77% to food service establishments. These numbers would indicate that if significant reductions are to be made in reducing food illness outbreaks, focus should occur where cost benefit ratio is greatest. This would dictate that food safety improvement efforts should occur in areas other than the processing plant. This forum was brought together to consider extending HACCP back to the live animal production arena.

As we developed HACCP plans, the hazards that we typically deal with in beef and pork slaughter and fab plants are the same as any food plant. They fall into the classical three categories of 1) Foreign material, 2) Chemical residues, and 3) Microbiological. In the foreign material category, the hazards that occur with the greatest frequency are bones (naturally occurring) and metal contaminants. Typically, the metal contaminant is introduced somewhere in the production system after the animal is slaughtered. Thus, a live animal HACCP would have minimal impact upon our two greatest foreign material contaminants.

Chemical hazards present in live animal tissues could potentially be introduced via the live animal and be present as antibiotic and/or pesticide residues. USDA and ourselves have routinely tested animal tissues for a number of years and have found the number of residue violations in feed cattle to be minimal.

Microbiological contamination involves both spoilage bacteria and pathogenic bacteria, with spoilage bacteria being by far the most common problem. Pathogenic bacteria, if they occur, typically are at very low levels in our facilities. This is especially true in our beef processing plants. Levels of pathogens in our beef plants are at such low levels that end product testing as a means of controlling them in a HACCP system is essentially useless.

Pre-harvest HACCP systems are currently being developed and are in some cases in place n many large commercial livestock operations. In many cases, they are not called "HACCP" systems but go under different names. "HACCP" is nothing more than a name given to an application of "process control" as it relates to food safety. It is rapidly evolving in the pre-harvest arena and "process control" as it relates to food safety. It is rapidly

evolving in the pre-harvest arena, and government's place is to aid and assist through education and information but not via the regulatory method. Pre-harvest HACCP will evolve as a market driven food safety system.

BIOGRAPHY

Dr. Dell M. Allen is a native of Kansas who is Vice President of Quality and Training for the Excel Corporative of Wichita, Kansas. As a Professor of Animal Science at Kansas State University, he taught a variety of courses in the area of animal/carcass evaluation and for 13 years coached the KS Meats Judging Team. He also worked for the Chicago Mercantile Exchange in market surveillance and compliance and has consulted with several of the major meat companies in the U.S. as well as in Canada and Brazil.

DR. H. WESLEY TOWERS, JR.
U.S. ANIMAL HEALTH ASSOCIATION

USAHA/STATE

I very much appreciate the opportunity to speak to you today on the subject of animal production food safety that will most certainly be focused more and more upon each year as we move into the 21st Century.

I will approach this subject first from my perspective as Chief, Animal Health, Animal and Poultry Health Disease Control Official in a state, and then from my perspective as current President of the United States Animal Health Association.

I would like to begin by congratulating Under Secretary Taylor and Dr. Buntain for their willingness to assemble this great pool of knowledgeable individuals from all over the country to listen to their ideas and suggestions and to get their views of the animal production food safety problem--and all of this is occurring before FSIS policies and procedures are finalized.

I believe that it is important in this era of diminishing budgets that notice be taken of the resources FSIS can tap into to avail themselves of in getting this program underway.

Some specific resources would be the specific research projects carried out by ARS, the industry-initiated quality assurance programs, and the current FSIS tissue residue avoidance programs.

I believe all of the different contributors and the expertise they have to offer should be thoroughly analyzed and evaluated. At this formative stage in FSIS food safety policy development, some ideas may be capitalized on, while others are discarded and strong points of one program saved and while learning what to avoid by studying the track record of longer-running programs with state involvement and signed Memoranda of Understanding.

I am sure that all of the stakeholders in this food safety issue, FSIS, the states, researchers, and industry, are most anxious to lend their support in making sure that U.S. citizens continue to have the safest food possible in the world, and yet none of those groups wants to be unfairly singled out and the finger pointed at them for being negligent for allowing outbreaks of foodborne illness to continue to occur.

I am especially pleased to see that FSIS recognizes that food safety requires attention throughout the chain of production, beginning with the live production unit and progressing through transportation, processing, distribution and finally, sale of the finished product. Everyone, including the final consumer, bears a responsibility for achieving the ultimate goal of no one gets sick from eating meat, poultry or eggs produced in the United States.

As I stated previously, there is not one of us that wants to be even remotely implicated as being the source of a foodborne illness. Everyone still remembers the states involved and the name of the fast food company that served under-cooked hamburgers contaminated with *E.coli O157:H7*. Everyone still remembers the name of the ice cream company that had a nationwide recall of its products because of a problem with SE.

Even though it is not directly our responsibility, it would be of a great personal embarrassment to the chief animal disease control official in a state to acknowledge that animals or poultry produced in this state were the source of human illness-producing microbes.

Since the early days of the *Salmonella enteritidis* problem in eggs, our Department of Agriculture and the Department of Health have had a signed MO, stating that where Delaware foreign products were suspected of

being implicated in a foodborne illness, our inspectors would be responsible for all tracebacks and on-farm visits, and this is exactly how it should be.

Who else knows their state's animal and poultry industry better--better than the animal and poultry disease control officials in that state? Who knows more about local production methods, marketing practices, callers, dealers, and livestock auctions? Who knows better what state authorities already exist that might be of some help when a problem does occur?

Some examples would be livestock dealer and auction market laws which require proper record keeping. Some states have mandatory animal identification laws, and some states already have authority to quarantine or detain any agricultural products which are contaminated and found unsafe for human consumption. And, finally, who else has had years of experience with another program having very similar goals and objectives? The tissue residue program, where almost all states are either under contract or have signed a MO with FDA.

Why, would you ask, are state officials interested in taking on additional responsibilities in animal production food safety? Because our producer groups are the people that we serve. Our customers, if you will.

What good is a disease-free livestock or poultry industry if they are perceived as harboring or intermittently shedding human disease-causing microbes which might contaminate the final raw meat product? The implicated group would be severely discriminated against in the marketplace, resulting in dire economic consequences. None of us wants to see the loss of, or a severe decline, in a segment of our state's agricultural economy, and it's for sure that our bosses, the secretaries or commissioners of agriculture, don't either.

It would seem that our personnel with years of local experience rather than a federal agent with no local ties or recognition could certainly raise the comfort level of our producers while investigating a potential problem.

In addition, many of our department s of agriculture now have public information officers who, if there were a local problem uncovered, might be able to handle the media aspects a little less sensationally than might otherwise be the case.

Many of the states also have excellent diagnostic laboratories with very capable microbiologists on their staff. These microbiologists might be given check samples by the National Veterinary Service Laboratories just as the diagnostic laboratories are now sending diagnostic check samples. Then, if there should be a problem in the future and a quick turn-around microbiological result is needed, these nearby laboratories could be utilized rather than having to pack the specimens and send them to NVSL for testing.

As I mentioned earlier, I do not believe there is any state that would not lend its expertise to help its livestock or poultry industry if it was incriminated as the source of a foodborne illness. However, all states are certainly not in the same financial situation, where they can commit extensive resources to help trace, identify and confirm the suspected production unit. I believe that FSIS will have to follow the example already set by FDA in its tissue residue program.

In this program, which is now working smoothly in almost all states, state personnel visit the implicated farm, investigate the violation, determine the cause and give the producer some advice on how to prevent the problem in the future.

Each state has entered into a formal agreement regarding their commitment to this project. Some states signed an MO and agreed to investigate the few cases generated each year in their state simply as a service to their industry. Other states, such as large dairy states that have many violations in a year, would be overwhelmed by the drain on their manpower and resources if they were not compensated.

These states have signed contracts with FDA which provide them compensation for completing these investigations. State officials want to help their livestock and poultry industry stay profitable. They would prefer to send their employees rather than federal personnel to do the leg work on a problem farm because of the comfort level it would afford that producer, and they would be glad for their laboratories to perform some culturing if it means the producer can receive negative results and move his animals to slaughter several days sooner.

However, FSIS will have to approach each state individually to determine if this pool of local knowledge, expertise, manpower, and laboratory service could be utilized with or without compensation. Even if a state could not handle the extra duties without some sort of payment, I am sure the use of this local talent would prove to be most cost effective.

As evidence that the states are concerned about animal production food safety issues, a resolution was passed at last year's USAHA meeting by the National Assembly of Chief Livestock Health Officials, which stated, "USDA, FSIS, and the USAHA should work together in establishing a working group of state and federal animal health officials, livestock and poultry producers, research workers and other related groups to address the issues of pre-harvest food safety and other related food safety issues." At least four other USAHA standing committees passed resolutions of similar content. This request for the formation of a working group is certainly not without prior precedent.

The Tuberculosis Committee Working Group has had great success with its members from the scientific community independently evaluating the efficacy of new supplemental TB test procedures for use in cattle and cervidae. Other members of the group helped establish the Bi-National Tuberculosis Inspection Group, which travels on site to evaluate the equivalency of the TB eradication efforts of several Mexican states as compared to the United States.

Just three months ago, when adverse publicity arose suggesting a possible link between Johne' and Chron's disease, I was asked to establish a working group. That group has already had its initial meeting at the LCI Conference on April 4.

Perhaps the USAHA action that would most impact this group gathered here today would be the formation of the Feed Safety Committee. As a matter of fact, this committee was formed at the suggestion of Dr. Bert Mitchell, who's here today, of FDA, to act as a means of addressing the problem of *Salmonella* in animal feeds. its contribution of improvements and solutions to this problem has been most impressive. During the three years at which the Feed Safety Committee has been in existence, they have produced guidelines for *Salmonella* reduction in the transportation of feed ingredients, on-farm guidelines for *Salmonella* reduction in broilers, turkeys and egg layers, and standardized baseline Salmonella monitoring procedures for use by microbiologists.

In addition, this committee has promoted and facilitated communication and understanding between industry, government and academia on the problems of feed safety with free exchange of ideas and information among these groups.

In response to the resolutions passed at our meeting in Grand Rapids, I have appointed a working group made up of state veterinarians, most of which are involved in their state's meat inspection programs, several members of the academic community, the chairman of the *Salmonella* Food Safety and Feed Committee, and representatives of the various industry organizations.

Our willingness to work with Dr. Buntain's group was conveyed in a letter to her, dated January 26, 1995. Dr. Buntain knows of our interest, and early on has included me on the Planning Committee of this forum.

We are most hopeful that, by the time of our meeting in late October, an announcement on the final version of the February 3 proposed rule on pathogen reduction hazard analysis and critical control point system (HACCP) will be ready to be made public. I would like to invite Mr. Taylor to be the keynote speaker at our Monday joint session of the United States Animal Health Association and the American Association of Veterinary Laboratory Diagnosticians, to make the first official announcement of the direction his agency will be taking as they implement these new concepts in food safety.

I, personally, look forward to working with you, Bonnie, as we have in the past, on the tissue residue avoidance project. I offer you and your group whatever assistance I can personally give and whatever service our organization can provide in acting as a science-based problem-solving national forum where the issues on animal production food safety can be discussed, consensus reached, and decisions made that will ultimately influence the level of safety of our nation's food supply.

BIOGRAPHY

Dr. Towers was appointed State Veterinarian for Delaware in 1969 and continues to hold that position. He is a Past President of the DVMA, two times Past President of the National Assembly of Chief Livestock Health Officials, and is currently President of the USAHA.

Dr. Towers received a B.S. with Distinction in Animal and Poultry Sciences - Pre-Veterinary Medicine from the University of Delaware College of Agriculture. He graduated from the University of Pennsylvania School of Veterinary Medicine, earning a V.M.D. degree. After graduation from veterinary school in 1968, Dr. Towers worked for the Delaware Department of Agriculture in its meat inspection program. He continues to work for the Delaware Department of Agriculture.

MS. NANCY ROBINSON
LIVESTOCK MARKETING ASSOCIATION

MARKET/DEALERS

As I began to prepare my remarks for this panel, I found myself struggling to define the marketing sector's role and responsibilities in preharvest food safety. This was in large part because there is a lack of understanding or knowledge, certainly within our industry, about just what preharvest food safety is.

What I do know, however, is that marketing practices are changing dramatically in today' s livestock industry. The big stockyards, once located in major cities throughout the Midwest such as Kansas City, Chicago, and Omaha, are in decline if not already out of business entirely. Auction markets and other fixed marketing facilities, once numbering in the several thousands during their heyday in the 1950's and ' 60's, now total less than 1700 nationwide . Whereas today, livestock dealers and order buyers are growing in influence in the marketing of livestock in the United States.

Where once almost all classes of animals were sold through livestock marketing facilities, typically referred to as sale barns, stockyards, or auction markets, today few slaughter animals are sold through the markets. Where once the market facility was the central point at which livestock was concentrated and commingled, today livestock are concentrated at feedlots or swine confinement operations, packer buying stations, dealer holding/sorting facilities and auction markets. Where the markets were once the principal intermediate intervention point in controlling animal diseases from spreading from farm to farm, today direct or country sales, video or electronic sales, and strategic alliances that bypass the markets are changing the scope and direction of many of our animal health prevention and intervention programs.

However, it is not my intention to absolve the marketing section of responsibility in the preharvest food safety arena simply because we no longer are what we once were. Indeed, the markets remain a strong and viable industry in the marketing of certain classes of animals, such as feeder and cull animals, and continue to be an important marketing alternative for the average or small-sized producer. Nevertheless, if our task here this week is to define the roles, responsibilities and strategies for animal production food safety, it is important that we all look beyond our traditional roles and be prepared to respond to a dynamic, changing industry that will likely look much different in the 21st century than it did in the 20th .

So what should we expect of the marketing sector in a preventive approach to preharvest food safety and what does the marketing sector expect of others in the food safety chain?

1. Livestock market operators are expected to the greatest degree possible to maintain the health and economic viability of their consignor's animals through the marketing process. Doing so sometimes presents a particular challenge since animals come to the markets under and in various conditions and numbers and are moved through the markets in a matter of hours, not days.

   With all those challenges, however, we expect that the livestock markets will continue to meet reasonable, effective health and sanitation standards in a preharvest food safety setting and to whatever degree feasible minimize stress and handling of the animals in their care.

2. We expect that whatever preharvest food safety measures or controls are devised by the regulated industry as well as the regulators that they will be built on practical, workable, science-based approaches that will not unfairly burden or do harm to another sector of the livestock industry. There are any number of animal health officials, as well as individuals in the livestock industry, who believe that life would be made much simpler if all livestock went direct from farm to farm, farm to feedlot or

farm to slaughter without benefit of intermediate marketing points. This just isn't going to happen, any time soon anyway, since markets still provide a valuable function and service to the livestock industry. The small average-sized producer still needs the market and dealers to provide them with a competitive outlet for their animals. So I would say to those who harbor thoughts of our demise—get over it and let us get on with devising preharvest food safety programs that make sense for all sectors of the industry and that don't establish regulatory or programmatic barriers or roadblocks to any particular industry sector ' s economic health .

3 . The markets expect that preharvest food safety programs will be flexible enough to accommodate different regional marketing practices and climatic conditions. One size seldom fits all and the livestock marketing sector is no exception when it comes to animal health or food safety matters.

4. All intermediate marketing points should be equally responsible for maintaining established preharvest food safety activities, including the buying station, the dealer holding facility, the sale barn and so on.

The market sector can be a significant force in moving the preharvest food safety agenda forward if we are given the information, the science and tools to do it. We at LMA are committed to working with all parties concerned in reaching a consensus on preharvest practices or controls that works for the industry and works for the consumer for whom we ultimately serve.

BIOGRAPHY

Ms. Robinson was born and raised in rural Kansas. She received her Bachelors Degree in History from Fort Hays University in Hays, Kansas. Nancy later taught history and government in a small rural high school in Kansas before returning to Hays University to obtain her Masters Degree in Political Science.

In 1974, Ms. Robinson began a 15 year career in politics and agriculture policy in Washington, DC. Nancy served as a legislative aide and later chief of staff to Congressman Keith Sebelius of the First District of Kansas until 1980. Nancy was appointed by the Reagan Administration in 1981 to the position of Deputy Director for Legislative Affairs for United States Department of Agriculture's Food Safety and Inspection Service (FSIS). In 1983, she was appointed to the position of Director of Information and Legislative Affairs for FSIS and later served in a similar position with USDA's Animal and Plant Health Inspection Service until 1988.

Ms. Robinson joined the Livestock Marketing Association, a national trade association based in Kansas City, Missouri representing 1200 livestock marketing businesses in the United States and Canada, in 1989. Nancy, who serves as LMA's associate manager for government and industry affairs is responsible for the full range of legislative and regulatory issues relating to the marketing sector and the livestock industry, including animal identification, food safety, animal health and animal welfare matters. Ms. Robinson also serves on the board of directors and executive committee of the Livestock Conservation Institute, a national livestock organization concerned with animal health, food safety and animal welfare issues.

DR. JAMES E. SEARS, D.V.M.
Robert Smith, D.V.M.
Dee Griffin, D.V.M.

VETERINARY PRACTITIONER (FEEDLOT)

The purpose of this forum is to discuss ways to reduce microbial pathogens from the farm to the slaughter plant, with the ultimate goal of improving food safety. A major focus is to consider possible risk reduction measures in animal production practices. Food safety is obviously a laudable and important goal, and one on which we can all agree. It is certainly a fundamental principle in feedlot practice and within the beef industry as a whole. However, it is important that we exercise caution if we are to avoid major disappointments and problems. Our efforts should be based on two primary principles:

A. Sound science
B. Industry driven and focused on food safety.

Sound Science

HACCP is a scientific approach. It strives to identify problems, find areas where intervention is effective and indicated, implement the intervention and then evaluate and monitor the results. Such systems are already in place in most feedlots right now. The Beef Quality Assurance (BQA) and Total Quality Management (TQM) programs which have been developed by the beef industry are essentially HACCP programs in cattlemen ' s language in the production setting . A simple example is residue avoidance. To consistently avoid residues, proper withdrawal times must be observed, which means we need proper animal identification and treatment records. Because the records are kept by people, the people need the proper tools and training. As a result, a large portion of feedlot practice is spent educating and training the personnel who are caring for the cattle, and then monitoring and evaluating the results. Many other examples could be cited where veterinarians and producers seek improvements and implement interventions as a result of this ongoing activity. Here are a few statistics to consider:

1. 99% of feedlots over 1000 head capacity report that they work with a veterinarian in some capacity. (NAHMS, COFE Report, 1995)
2. 83% of feedlots over 1000 head capacity report some change in methods of administering animal health products in the previous 5 years based on quality assurance or food safety programs. (NAHMS, COFE Report, 1995)
3. Since 1991, as result of Beef Quality Assurance (BQA) programs initiated by the National Cattlemen s Association (NCA), the incidence of top sirloin quality defects has been significantly reduced. (NCA Beef Quality Audit, March 1995)

But it is not enough to just have a scientific approach. We must also have good, sound biological science as a basis. In spite of some excellent work which has already been done, we need additional fundamental research before we can consider potential interventions in which we and the consumer could have any confidence. For example, with respect to colonization and shedding of *E. coli O157:H7,* do we know the effect of such things as diet, previous therapy, weather and environmental interactions, previous diseases, subclinical diseases or immune function? Are there other significant reservoirs of the pathogens? We could theorize on several potential intervention points, but until we have good answers to these and other questions, instituting a pre-harvest regulatory program is almost certain to fail. It might be like throwing a chunk of coal into the fuel tank of the space shuttle and then wondering why it doesn't go. HACCP is the space ship but sound science must be the rocket fuel and the fuel is not yet available in sufficient quantities. Even worse, it might be like a real-life example, zero tolerance. The zero tolerance program was initiated by FSIS in reaction to a very serious problem which occurred because a known preventative measure, proper cooking, was not followed. Zero tolerance had a

commendable goal and it sounded good to consumers, but it was not based on facts and good science. The result was and is that tremendous economic damage was done to the industry and food safety was not improved. A survey of 14 major packing plants conducted by the American Meat Institute in 1994 examining *E. coli O157:H7* carcass counts found 3 plants with lower counts, 1 with the same count, and 10 with higher counts than before zero tolerance. In addition, a wash/trim study conducted by Colorado State University, Center for Red Meat Safety, has demonstrated no advantage for knife trimming over washing in reducing bacterial counts on carcasses. In fact, the study indicates that knife trimming may increase contamination by carrying microbes into the tissue. This study is soon to be published in the 1995 Journal of Food Protection.

One other point regarding the science. One would hope that we can all agree that any potential interventions which research might reveal must be reasonable and practical. Zero risk is impossible to achieve. Almost nothing in nature is absolute or static. No vaccine or therapeutic agent is 100% effective. No disease process or pathogen behaves the same every time. No two animals function entirely the same. And so the reality of a changeable, biological entity must be recognized and common sense employed . That means consideration of the economics, even though it must take a back seat to safety. It would not be possible to design programs that would add intolerable costs to the point of making beef production a nonviable economic enterprise. Going overboard chasing vanishing zero could end up hurting the people we are trying to serve, the consumer. To continue with a space analogy, suppose it is found that exposing cattle to the zero gravity of space significantly reduces 0157: H7. Would we institute the intervention of booking cattle on flights on the space shuttle? Obviously not, because it would be impractical and cost prohibitive.

Industry Driven and Focused on Food Safety

The second principle mentioned was that any program should be primarily industry driven, as opposed to regulation or agency driven. This is not to say that a government agency should not be involved, such as APHIS, as some have suggested, or FSIS. But it is not likely that a heavy-handed regulatory approach will achieve the best results.

It should also stay firmly focused on food safety. That sounds overly simple and obvious, but when well-intentioned, educated people get together discussing ways something might be improved, it is easy to start suggesting this procedure or that practice "would be nice" even though it may not have an impact on the main event, which in this case is pathogen reduction and food safety. Everyone should resist this temptation. The free market is the best and most cost-effective way of determining good management procedures. A practice should be considered only if it will result in a predictable, measurable improvement on food safety.

Summary

We would again emphasize that we should proceed with sound science as the basis, or we will fail. And if we promise the consumer and fail, we all lose. Much more research is needed before we should even consider a pre-harvest program. One could speculate that effective preharvest methods may be difficult or impossible to achieve, due to a variety of reasons, and that post-harvest methods may continue to hold the key to success. Therefore, the focus now should be to establish research priorities, and to pursue those research projects. Some of those research priorities have already been suggested by the Livestock & Meat Board Blue Ribbon Task Force earlier this year.

We should also avoid excessive regulation and bureaucracy by utilizing an industry driven, free market based, cooperative approach and also make sure the focus is food safety.

If practical, cost-effective intervention opportunities can be found which will demonstrably improve food safety. The feedlot industry, in cooperation with the veterinary profession, is ready, willing and able to institute the

interventions in the already existing Beef Quality Assurance (BQA) and Total Quality Management (TQM) programs. That approach will best serve the needs of everyone by continuing to assure the consumer of an ample supply of safe, wholesome beef at a reasonable cost.

BIOGRAPHY

Dr. Sears received his D.V.M. from the University of Missouri, and his B.S. from the University of Nebraska (Animal Science). Dr. Sears has been in a feedlot consulting practice associated with Del Miles of Greeley, Colorado. The practice is now known as Veterinary Research and Consulting Services (VRCS), with five veterinarians. VRCS currently provides consulting services to operations that feed over 1 million cattle annually with clients in Colorado, Kansas, Nebraska, Texas, New Mexico and Idaho. VRCS also conducts studies to evaluate product efficacy and production parameters. The central office for VRCS is in Greeley, Colorado.

Dr. Sears was in mixed practice for 11 years, primarily cow/calf and feedlot work. From 1976-1979, he was in Hyannis, Nebraska, where the clientele was almost exclusively cow/calf. From 1979-1987, he was almost exclusively cow/calf. From 1979-1987, he was in mixed practice in Bridgeport, Nebraska. The practice was mostly bovine work, both cow/calf an,d feedlot.

Dr. Sears' professional association experience includes the Academy of Veterinary consultants (AVC), the American Association of Bovine Practitioners (AABP), the National Cattlemen's Association (NCA), the American Veterinary Medical Association (AVMA), the Nebraska Veterinary Medical Association (NVMA), and the Nebraska Cattlemen.

DR. JERRY GILLESPIE
KANSAS STATE UNIVERSITY

RESEARCH COMMUNITY

I wish to join others in expressing my sincere appreciation to Under Secretary Mike Taylor and to Bonnie Buntain and her associates for organizing this forum. I have to believe that this will prove to be an important milestone in improving food safety.

To tell you the position and commitment of the university community in the area of food safety research, I must first tell you some things about major changes that are occurring in higher education.

"Times are changing" at most universities. Resources for universities have been limited or decreasing over the past two decades. There are very few public or private universities that have not had their core budgets cut over the past few decades. The message from the public is clear. "Do more with less." I want you to understand that the message has been delivered, and the message has been heard. Universities are reviewing and prioritizing programs and downsizing is occurring. It is painful; it is controversial, but it is occurring.

These reviews within the universities include teaching, research and service, which is leading to changes in goals, missions and to a real cultural change in universities--and I emphasize "cultural change" because this is never easy.

How do these this affect research in universities and specifically research in the area of animal production food safety research?

First, universities are now involved in some very important food safety research and several universities are committed to being full partners in providing the needed science for improving food safety practices from the farm to consumer. Several universities have formed consortia to improve their food safety research effectiveness and scope.

Second, many universities are committed to improving management of food-borne diseases by physicians and by the public health officers nation-wide. This commitment has led to new research and to improved educational programs for physicians, veterinarians and public health students in some health science schools.

Third, university faculties are often well positioned to be a major part of improving the education of those who will be the food safety scientists and technicians of the future.

Yesterday, as part of this forum, members of a work group on research accepted as a "given" that research resources in the foreseeable future will be severely limited. Competition for these resources will be fierce. Two questions emerge; how can we make the best of these major changes in universities and in downsizing of resources? and how can we assure that there is high-quality research done in the area of food safety research in a period of restricted funding?

In part, because of the scarce resources within universities, there is more critical and comprehensive review of research programs and more review of their quality and productivity. Increasingly, the question will be asked, is the research in the service of humankind? It will be increasingly unacceptable to have faculty alone set the research agenda, and they will be no longer shielded from critical public review. Universities will be continuously confronted with the struggle to balance being accountable to the public and maintaining independence and an unbiased position in their research.

Like all shareholders in food production, university researchers have important and needed resources to bring to the "table." They need to be at the table to help set priorities, to assist in the review of research and, importantly, to provide the needed basic, applied and integrative research in the area of food safety. Universities must maintain as part of their culture a dedication to excellence in research, which includes critical and thorough review of their research proposals and their research outcomes. Increasingly, academic researchers will need to build multi-disciplinary research teams across their universities, across state lines in other institutions, with governmental agencies and with industry. In building research partnerships, each shareholder will need to share ideas and resources and, most importantly, a commitment to work together. In this time of limited resources for research, we need to look at models that will allow academia, governmental agencies and industry to work from a common list of priorities and from a common pool of research funding. We need a model that will assure the best, highest-priority, research is done with the resources available.

It seems to me that one of the shared views of many at this forum is that we need new science-based technologies to improve food safety. University researchers are now and will be needed to be partners in the research that defines and develops these new technologies. To achieve the quality of research needed, it is our view that research proposals from universities, government laboratories and industry funded research should be critically reviewed for quality and importance. It should no longer be acceptable to fund laboratories or researchers for any reason other than to conduct high-quality, high-priority, research in the service of humankind.

There is a growing opinion among researchers that there should not be a prejudice against applied and integrated research in favor of basic research. Instead, all research should be prioritized according to its quality and its value to humankind. Further, new technologies emerging from food safety research should be subject to assessment outcome studies in the field. In short, we must be prepared to do all that we can to assure economic efficiencies and high-quality outcomes from science done by universities, by government laboratories, or by industry.

In summary, from this forum, I hope there will be a shared vision and commitment to improving the quality and application of food safety research. Research which will provide economically sound technologies and management practices will improve food quality at every step in the food chain. If we are committed to doing this, we can expect to improve the wholesomeness of our food supply, enhance our food-products appeal in the world market place, and substantially decrease the chances of serious foodborne illness world-wide.

BIOGRAPHY

Dr. Gillespie has been the Director, Food Animal Health & Management Center at Kansas State University since 1994. His previous work has included professorial and departmental lead positions at Kansas State University and at the University of California. His special appointments include: Principal Investigator, Interinstitutional Food Animal Production Medicine Consortium; Project Leader, Vision 2000 Pre-Harvest Food Safety; Visiting Faculty Fellow, Harvard School of Public Health, and Visiting Faculty, Centre National de la Recherche Scientifique, Strasbourg, France. He graduated with a D.V.M. from the Oklahoma State University, received his Ph.D. from the University of California, Davis, and received a Diplomate from the American College of Veterinary Anesthesiologists.

MR. AL POPE
UNITED EGG PRODUCERS

POULTRY—EGGS

I'm here representing egg producers and further egg processors. I think one of the efforts that you should try to make is to try to get actual producers here rather than those of us that just represent producers.

The egg industry is really a small industry by the standards of other livestock commodities. The United Egg Producers is an organization that represents producers that produce 83 percent of the Nation's eggs. The United Egg Association, an organization that represents, among other groups, the further egg processors that have a program under FSIS called the Egg Products Inspection Act. (It has been moved from AMS to FSIS.) That group represents over 93 percent of all the egg products that are made in the United States.

So, while we have a small industry, we also have a small UEP and UEA. You are looking at 20 percent of our entire staff! I'd like to show you what, in spite of our small resources and few numbers of people, you can do when you're in real trouble.

In 1988, we had an announcement from CDC linking *Salmonella* and Grade A eggs. This was a major concern to the industry and had a dramatic effect right away on the industry. We have about 350 producers now, and out of that 350 producers that are left, there are about 60 producers that represent about 65 percent of the total U.S. production.

This morning, I'd like to show you an example of what we think is a HACCP program, a very simplified one. At the same time, I have some things that are not so nice to say, but hopefully we can learn from some of these.

After the announcement in 1988, I think the Administration's regulatory officials would be hard-pressed to find an industry that was more cooperative than the egg industry. Since 1988, I have met with CDC, with FDA, and with USDA every quarter, I believe, working on food safety and working on the issue of *Salmonella* in eggs. Some great things have come from that, and I'd like to talk about those in a few minutes. In the meantime, I've been honored to work with some just fantastic people, and these people have been very sincere in their efforts in trying to work with us and trying to help us. I really appreciate that, and there's just not a lot of people like these. I've worked with Dr. Mason, Dr. Hogue, Dr. Kradel, Dr. Hensler, Dr. Morrie Potter, Dr. Schlosser, Tom Schwartz and Joe Madden at FDA, and, of course, Tom Gomez, who has also been assigned down at CDC. There are lots of others, and they have honestly really tried to help us in a great way.

However, the egg industry has nonetheless been bombarded by the news media and just bombarded with mis-information. This is the part that has really hurt. As you can see, it's hard for us to respond to that, and this is where we need a great deal of help and a great deal of cooperation. In fact, in the last 60 days, we've had CDC officials actually saying to the news media on the West Coast that one in a hundred eggs are contaminated, with no explanation. It has caused us just loads and loads of problems.

I heard earlier this week some wonderful words. They were words like trust, cooperation, partnership, etc. First of all, eggs are marketed farm-to-table, which, I think, like broilers, is an advantage because we are vertically integrated, and we can respond at almost every level quickly. So, that allows us to put a program together, get approval from our board and work on it right away. I heard Bonnie earlier say vision, mission and goals.

In the last six months, we've had our FDA Commissioner accuse, indict, try and find eggs guilty in the news media on the Schwann's ice cream outbreak, and this despite information that was provided by USDA and the industry. Even as late as last week, the FDA continues to refuse to meet with us.

What about these wonderful words of trust and partnership and cooperation? We've demonstrated our willingness to do that, and we've got a lot of people in the system that are willing to do that. But what about these other things that are so unfair?

This is the same agency (FDA) that supports the use of an egg centrifuge. This machine breaks eggs, co-mingles the liquid, the egg liquid with the shells, the feathers, the rodent and the chicken feces prior to cooking your scrambled eggs. We have had it outlawed in about 14 states, but we can't get the FDA to prohibit the use if it in a restaurant. This is terribly frustrating. For 10 years, we've been working on this.

I've provided the support material, both to FDA over the last 10 years, and I have again provided it to FSIS. We'd like some help on that. The practice goes on. It doesn't stop. We need help with this in order to gain this kind of cooperation and trust partnership.

What about the good news? We had to put together a food safety program in a hurry as a response to consumer demand, and we used HACCP to do it. Let me say that it all started with a couple of documents. One of them, in our industry, is called "Husbandry Guidelines, Management Practices," referred to as the GMPs. It has to be available on the farm before any good food safety program is put together. So, I think sometimes we've confused the two. We have to have this. Along with this, we did a recall manual, and those two are vital components of our food safety program.

When we started putting our food safety program together, we tried to do the responsible thing, and when we were done, we had 37 critical control points. So, we said, "What is this program to be for?" It is obviously supposed to protect the consumer and provide our customer a means of evaluating and, for ourselves, to provide a safe product. But it has to be identifiable. It has to be something that people understand. We went to some of our costumers, and these included Krogers and McDonald's, and we showed them our very detailed HACCP plan. They said. "No, no, no, that's not what we want. We want something to know that our suppliers are carrying out those things. They may have to do those 37 things, but we want only to check five or three or 10 critical points that we think that you think are the critical points in your industry."

So, that is what we did. We took our program and we developed a program called our "Five Star Program." I'd like to show you what made it possible because, without the cooperation of the USDA, without the cooperation of APHIS, without the pilot project, none of this would have been possible.

The first slide shows things that have happened since 1988. The outbreaks are down somewhat. There was the development of a USDA trace back program. We went to the Administration. They gave us the trace back, which we asked for. This trace back, of course, responded to the media concerns that we had. We have to remember that at the time, we couldn't even say *Salmonella enteritidis*. So this was really a bug that we didn't know anything about. There were a lot of unknowns in the beginning, other than the fact that we were getting our brains beat out in the news media. So, we had to have a response.

It certainly improved the industry awareness on cleaning and disinfecting and many other issues. We established the pilot project, and we went to Congress. The industry went to Congress and obtained the $3.4 million funding to fund the Salmonella Task Force.

As a result of the trace back program, five to seven years later we have identified food handling abuse as a primary source. There have been improvements in vaccine development, we developed proper food handling materials and educational materials, which we have sent to every one of our customers. That means every restaurant in the United States has received them, and I credit the American Egg Board (a sister organization in the industry) for doing that.

Thanks to the USDA Pennsylvania pilot project, and many other efforts, the role of the rodent and the need for rodent control was identified. Refrigeration legislation has passed—and Mr. Taylor, we need help with this, please—we need to get it implemented as quickly as possible. I know we can work together and get it done. The industry supports the refrigeration legislation strongly. We supported the increased use of pasteurized product in institutional settings over the objection of my own board.

The industry developed a HACCP safety program, a universal five-star program. First , we felt that the five-star program took the industry to a new plateau—from a defensive strategy to one of offense, so that we had answers. We were prepared. We had tried to be prepared. It will provide the consumers with the safest possible product. It provides the ability to meet varied marketing needs and not be a burden or restrict trade. This was the most difficult provision. For different geographic areas, we had different risks. We had high and low-risk areas. How do you develop a program that meets all the needs of the varying areas?

We did it by having five or six levels within the same program that producers could implement, depending on what they wanted to do, or they could tailor a total program within the structure of the universal program to meet their needs. Is it realistic? Is it simplified? Is it effective? It must be one that the industry and the individual producers will support. I have tried for the last three or four years, working with APHIS and now FSIS, to communicate this.

We worked this program out so that we think it is acceptable to the industry and to individual producers. It provides a strong, effective industry-educational program.

I don't want to understate it, because in our program, a commitment to the five-star program is a state of mind. It is one that , if management doesn't adopt it, it doesn't work. Our logo can be used on producers' stationery, egg cartons...they can use it in any way they want to. We have posters for their plants, for their processing plants, for their production facilities. So, when it starts, we basically get the management to commit to the program. It's a voluntary commitment, and that's how it comes back to us. They can post this in the office, and we have a copy back at our office. It's a five-star total management program. It features a HACCP program, food safety, pre-harvest, verification, and those are all key points, we think.

Like I said earlier, and this doesn't cover all the people, but you can see here all the folks from the APHIS task force, from the pilot projects, the folks over at FDA, the University of Pennsylvania, and Perdue Farms. There's just so many people that helped us put this thing together, and we really do appreciate it. Like I said, it couldn't have been done without the APHIS effort.

In the first paragraph, it says, "The program addresses and protects each critical point from the point of production to the point of consumer use, will provide full verification, if desired." You can use the word "certification", but it has the flexibility of doing any of those. And again, we believe that the food safety quality assurance HACCP program is designed to identify for the consumer those critical points that could be contaminated with bacteria. The program is simple, but it is effective. It must be verifiable with documentation.

These were the keys that we used. We picked out five that we felt were the most critical points to have documentation for. These are the critical points (slide), and these are the ones that all have documentation, must have documentation with them, so a customer can come in, whether it's Kroger or McDonald's or whatever, and they can say," Well, I want to see your records. We want to see your biosecurity records, your testing records. " And we have those.

Each star represents one of the five critical control points. The point I want to make is we went from 37 critical points to these five because we want people to understand it. Does that mean that we don't do the 37? No. Obviously, we have to do all 37, but these are the ones that they can check to make sure we're doing the 37. We

have producer options that include various levels of testing. So, actually, there are about six total levels that they can go to on the program. The last thing is, it is a pre-harvest program and it has verification.

One of the things that you asked when we came here was recommendations. Now, this is done a little bit tongue-in-cheek, and I hope you don't mind, but, you know, there happens to be so much conversation on "Contract With America." We thought maybe we'd have a contract with American egg producers. Is that all right? I'll just run through this (slide) real quick. Develop a HACCP educational program with and for the industry, including seminars, industry presentations, HACCP schools maybe; conduct continued research on food-borne bacteria, especially with an emphasis on, obviously, SE; and recognize the egg product inspection program as a successful food safety program model. I should say, because despite the criticism that we took from Commissioner Kessler, here's a program that's been in place for 20 years and has yet to have its first human outbreak trace back to the egg products industry. It is pasteurizing egg products. It's a fantastic program, run by the USDA. And the unfair, unproductive egg trace-back program—support UEP's Five-Star Total Quality Assurance Program as a universal program available to the industry; provide technical assistance when called upon; verification; certification; support the certification of food handlers for restaurants, hospitals, other feeding institutions; develop reasonable, balanced, and coordinated media releases and responses; and working with CDC and FDA, develop and carry out a responsible education program on food handling and preparation; and, of course, I mean the industry at the same time. That's the one that I think I've heard everybody refer to as facilitating.

BIOGRAPHY

Mr. Pope has been President of the United Egg Producers since 1978. He is also President and Founder of the United Egg Association, whose members represent 90 percent of U.S. egg processors and the major suppliers to the egg industry of service and equipment. He is also Council Member and Past Chairman of the International Egg Commission which represents the 30 leading egg-producing nations in the world. Among his activities and contributions at the UEP, Al has established the Egg Nutrition Center, coordinated an effective government relations program, facilitated the branded egg market, contributed to public trading and the establishment of egg values, developed the member satellite program ENN (Egg News Network), established animal welfare husbandry practices for laying hens, and developed the egg industry "5-Star" Quality Assurance Food Safety Program.

DR. CHARLES BEARD
SOUTHEASTERN POULTRY ASSOCIATION

POULTRY—MEAT

The Southeastern Poultry & Egg Association represents the broiler, turkey, and egg producers as well as those who are allied with these industries. It has a research grant funding activity providing $1.2 million annually to researchers who work on industry problems, including food safety. It sponsors the largest poultry exposition in the world held each January in Atlanta and it conducts a program on continuing education through its extensive seminar schedule.

I appreciate the opportunity to present an industry perspective on the important subject of Production Food Safety, particularly as it relates to the broiler industry. Because of the huge size and diversity of the poultry meat industry in this country, it is virtually impossible for a single individual to speak with much assurance that he/she is speaking for an entire industry. I do believe that much of what I say is representative of the opinions of many in the industry.

My remarks will be counter to the opinions of some of you. In some areas there will be minor differences and in others we will be on opposite sides of the table. That is one of the purposes of holding a meeting such as this: to hear the opinions of others so that we can come to understand their positions and how they came to adopt them. With an improved level of understanding, perhaps we can more effectively move toward that common goal of reduced foodborne illness. With these disclaimers stated, I'll proceed.

Many of us associated with the poultry industry are not convinced that the epidemiologic data incriminating poultry meat as a major cause of foodborne illness are solid. The wide ranges of estimates presented by experts on the incidence and causes of foodborne illness attest to the imprecise nature of the data. We believe that poultry meat has received unearned adverse publicity. The general public must also have doubts about the validity of the data because poultry consumption is continuing to increase in spite of negative publicity. As poultry meat consumption has increased 30% for broilers and 60% for turkeys since 1984, the incidence of culture-confirmed Salmonellosis in humans has either remained the same or declined since the milk-induced peak in 1985.

I believe that processing practices can't be expected to remove all bacteria from the skin of poultry. Because poultry exist in close contact with their excreta, their surfaces are contaminated with the bacteria found in the gut. Short of irradiation, the broiler industry cannot provide sterile raw meat to the consumer. Dr. Richard Forsythe calculated that it would take 135 irradiation facilities the same size as the one operated by Food Technology Services in Mulberry, Florida operating 20 hours a day, six (6) days per week to irradiate the 500 million pounds of broiler meat produced that week. One such plant can irradiate only 3.6 million pounds per week.

The bottom line is that even if the industry provided only fully cooked or irradiated poultry meat, that would not be the end of poultry-related foodborne illnesses. The product can be contaminated by the consumer, temperature-abused, and foodborne illnesses will likely result. Because these irradiated products could be erroneously regarded as not needing refrigeration, the incidence of food-related illnesses could actually increase beyond the rate associated with raw poultry.

Is it feasible to produce pathogen-free broilers? It sounds easy until you review the probable sources of pathogens even if the chicks, feed and rearing house were initially completely free of pathogens.

Where can the industry have the greatest impact? It is obvious that there can be more control over one slaughter plant than over 70 to 80 farms. The other characteristics of the broiler farms may make them a very difficult, if not impossible, site at which to implement intervention strategies.

We know that it will be extremely difficult to present *Salmonella*-free broilers to the slaughter plant if their parents were *Salmonella* positive. When one parent flock in Sweden was discovered to be *Salmonella* positive, fourteen progeny broiler flocks were found positive to the same serotype before they detected the parents to be positive. All grandparent and parent stocks must be *Salmonella*-free for there to be any hope of growing negative broilers. And then there is the feed. The link between serotypes of *Salmonella* in the feed and in the finished broiler is not so clear. There appears to be a relationship in some flocks and not in others. Feed samples analyzed in laboratories can result in a list of *Salmonella* serotypes distinctly different from those removed from broilers in the same geographic area. Broilers are already receiving heat-treated feed in that it has been pelleted and crumbled. Even if the feed produced is pathogen-free, it must be transported, placed in the feed bin and augered to the troughs without being contaminated by rodents, birds or insects.

Many of the broiler houses in the U.S. have open, wire sides with adjustable side curtains for temperature control. Most have dirt floors, wood supports and plastic covered insulation in the ceiling. None have change rooms and few have paved entry ways.

When a broiler farm is depopulated by catching and hauling the broilers to slaughter, it is necessary that catch crews come into the house, coops or hauling cages on trucks and come on the premise with front-end loaders to lift the cages up on to the truck bed. The crew and equipment are on different premises every night and sometimes more than one premise each night. In a few days to a week after the "loading out", new baby chicks are brought to the farm and placed in the houses for another grow-out cycle, about 6 ½ cycles each year.

To adequately clean and disinfect all of the loading and hauling equipment takes a lot of effort, a lot of water and a lot of disinfectant. The environmental concerns are obvious.

Competitive exclusion (CE) flora have performed well in the laboratory—not perfectly, but well-in reducing the incidence and level of pathogen colonization, primarily with *Salmonella*. Countries like Sweden and Finland rely greatly on the use of a non-defined CE flora "Broil Act" which comes from Dr. Nurmi's original finding over twenty years ago.

Bio-security will be a necessary component for producing pathogen-free poultry. A program of continuing education on bio-security is necessary for it to be effectively implemented.

The FDA has prohibited the use of the feed sterilant chemicals that are utilized in Europe. They are presenting a proposed mechanism for seeking clearance but experts in the feed area say that the FDA requirements are so unrealistically stringent that no feed chemicals will ever be approved. For example, they require that the proposed chemical inactivate several logs more of *Salmonella* than anyone has ever found in feed and that artificially laced feed must be used for tests, not naturally contaminated feed. The EPS and OSHA have just about stopped the use of formaldehyde in the industry until recently, when there was some relaxation on use-restrictions. It is an excellent hatchery fumigant and can also be an excellent decontaminant when used as a sprayed solution. It is widely used in Sweden, including for house decontamination on the farm.

While technically possible, it will take a lot of years, a lot of funds, and a healthy dose of dedication and good luck for the industry to present pathogen-free broilers to the slaughter plant. Sweden has managed to produce *Salmonella*-free broilers after a 20-year program. Their industry's production is about 1/320 that of the U.S. and they have made very little progress with *Campylobacter*. I will also add that even though Sweden has been successful in producing *Salmonella*-free broilers, the incidence of human Salmonellosis in Sweden has not declined. They attribute this lack of decrease to individuals becoming infected outside Sweden and returning home.

It would take untold sums of money and many years to bring the U.S. broiler houses to a physical condition compatible with the production of pathogen-free broilers.

Because of the relative numbers of slaughter plants to production facilities, the most feasible approach to the improvement of the microbiological quality of broilers is in the slaughter plant.

I know the heat is on, but this is not the time to impose an "armchair" production food safety program on the broiler industry. Now is the time for research directed toward the question: How can we grow pathogen-free broilers?

This may come as a shock to some of you, but there are those who believe that as noble an effort as food safety is, it is being used, especially at the production level, by some who want to benefit in other ways other than simply safe food. This is not to say that their goals aren't important or beneficial—they just aren't always confined to purely food safety.

To meet with any success, the efforts to improve the microbiological quality of raw poultry must be an "up front" effort, free of hidden agenda and selfish motives. We all know the industry must make a profit to stay in business and produce the food. They have never denied their reason for being in business. Any food safety initiatives cannot deny them that opportunity or society could seriously injure or even kill the goose that lays the golden eggs. There are many people in this society, some less fortunate than we, who depend on poultry as a reasonably priced source of protein for their families.

There is an aspect about the production food safety issue that is of great concern to the industry. We know that there are those who don't want us eating chickens or any other animal, those who want chickens raised on open ranges or at population densities far less than the economically driven current practice. There is concern that any eventual production food safety program that evolves from guidelines to regulations could be the conduit whereby these groups could use political pressure to impose their beliefs on the industry. That could be disaster for poultry production and the population who depends upon it for food. Caged layers are currently prohibited in Switzerland. They import most of their eggs now and guess what? They are produced by caged layers. Sweden has a law on the books that will outlaw caged layers in that country in 1999. Most egg producers say that their business will no longer be profitable and they will get out of the business. The Swedes will then import their caged layer-produced eggs as well. Animal Welfare/rightists can have significant political clout imposing a minority opinion on the majority.

The more we learn about producing pathogen-free broilers, the more difficult it looks. We need the research, not the program. If research results lead to a program, it must be tested under realistic conditions and proven to work before it is implemented. To do other than this is an unscientific knee-jerk response that will benefit no one. It is a distinct possibility that food mishandling is such a major component of the foodborne illness problem that it could overshadow improvements made as the production level, short of total exclusion of the pathogens, and as a result, there would be no measurable decline in foodborne illness.

For now, the reasonable approach is to direct our energies and skills at the slaughter/processing level. I believe we will get farther down the road toward a product of improved microbiological quality in less time and with available resources.

BIOGRAPHY

Dr. Beard received his Doctor of Veterinary Medicine from the University of Georgia in 1955 and his Ph.D. in Virology and Medical Microbiology from the University of Wisconsin 1965.

He was researcher and then Laboratory Director at the USDA Southeast Poultry Research Laboratory 1965-1993. His primary research interest was Newcastle disease and Avian Influenza. Dr. Beard developed the AGP serologic test for Avian Influenza which has been so important in the control of that disease. He has been a member of the APHIS Advisory Committees for both the 1972-3 VVND and 1983-4 Avian Influenza eradication efforts. He served as Vice Chairman and Co-chairman of the Second and Third International Symposium on Avian Influenza. He was one of the Editors on the Ninth Edition of the Disease of Poultry and has served on the editorial board of Avian Diseases from 1974 to 1993. He served as co-chairman of Avian Medicine section of the AVMA scientific program committee for four years and as President of the American Association of Avian Pathologists.

Dr. Beard joined the Southeastern Poultry & Egg Association in April, 1993 as Vice President for Research and Technology.

His honors include the USDA Superior Service Award, the Congressional Excalibur Award, the American Association of Avian Pathologists Service Award, and the "Workhorse of the Year" Award from the Southeastern Poultry & Egg Association.

He is a charter Diplomate of the American College of Poultry Veterinarians.

MR. JOSEPH POCIUS
NATIONAL TURKEY FEDERATION

TURKEY—MEAT

Congratulations to the agency for taking this first step in what will probably be a very complicated process. Most of what I'm going to say today, and I'm not going to take as much time as most of the other speakers, will be subject to change as we go back and discuss this with our industry committees. As Director of Scientific and Regulatory Affairs for the National Turkey Federation, I've been given the dubious honor of developing a HACCP plan for the turkey industry and, to be quite frank, I agree with the other speakers who have already stated that it is the federal government's responsibility to establish some epidemiological link between human Salmonellosis and the efforts that we're going to embark upon.

Equally as important, we recognize that perception is reality, and if there are very many industry folks out there, I would challenge you to go back to your marketers and ask them about that. I'm sure that you'll find that perception in their eyes sells product, and it's not hard to understand. All you have to do is look at Grey Poupon. That product is just crushed seed, bad wine, and a little vinegar, salt, and it charges you $10 a bottle. Perception is important.

Whether or not we have the hard data available today, NTF will go forward with this, and we will develop our plan. I've been given the honor of developing a HACCP-type of micro-program, and I say HACCP-type for a reason. It's becoming apparent that HACCP as it's described by the National Academy of Sciences may not be completely applicable to animal production.

HACCP is a process control program designed for rapidly changing food processing systems. Now, production agriculture is also a dynamic and changing system, but it does not change at the rate of 30 to 50 birds per minute as it does in processing. You have to keep in mind the relative things that we're talking about here.

However, there are certain principles of HACCP that may be applied to animal production. In particular, those that involve hazard analysis. Now, as a point of illustration, we need to look at the contiguous flow from the primary breeders all the way down to the meat bird area. While this flow is continuous, it is not contiguous. For instance, it was mentioned there is a two-stage and three-stage pork production. Similar to that, we have three discreet operations in the turkey industry—primary breeder operation, the multiplier stage, and the meat bird stage. These operations occur separately, in different facilities, and at different locations. Because these operations occur separately, using this flow chart to identify critical control points for the entire production cycle, which is required in HACCP, would not give a cogent fluid HACCP model. This is the first reason HACCP may be ill-applied. Each of these areas needs to be handled discreetly.

The National Advisory Committee on the Microbiological Criteria for Foods defines a critical control point as a point where control can be applied to prevent or reduce to an acceptable level food safety issues resulting from chemical, physical or microbiological contamination.

Actual critical control points do not exist as they do in a processing environment. For example, in processing, a critical control point is a physical point on the processing line that may be stood next to, pointed at, or touched. It's a point on the line. Process sanitation programs and sanitation in the processing environment, as important as they are, are just that. They are programs. They're not physical points, and they are not critical control points.

In production, there are many programs that exist and others that can be developed to address areas of concern. However, they are all programs, not points in a process. For example, NTF has developed a residue avoidance program which has effectively maintained negligible levels of unacceptable residue contaminants; that is, chemical contaminants.

This program looks at the feed, water, bedding, many other materials before they enter a production facility, and it is managed at each of these three operating areas separately. We are looking at this program now to see whether it can be modified in the sampling that we do and see if it can't be modified to include micro-issues. Nonetheless, it is still a management program. It's not a critical control point, and it is not HACCP.

Additional programs, such as clean-out and disinfection, bio-security, rodent control, and others, which would be clean-out and disinfection, and which would be very similar to process sanitation, can all be managed in each of these operating areas, but they are not HACCP, and neither one of those is a point. They are not critical control points, and it's important to be clear about this because it will affect what the expectations are of these programs.

We can't get the same results in a production setting that we can in a processing setting, and if we expect that we will be kidding ourselves. Ultimately, what may be developed is a broad umbrella program which will require the inclusion of and management of each of these different programs together. This may be done under an existing GMP framework, for instance, and I say framework for a reason.

NTF is also looking at the USAHA's program for *Salmonella* reduction in turkey production to see how this information, which represents many, many hours of expertise can be used to our advantage. Another way of saying that is that we really don't need to reinvent the wheel every two to five years.

Finally, the term "food safety control point program" was suggested by the TAG Group, and I would recommend that FSIS give that serious consideration. The reason for using a program name, such as food safety control point rather than GMP, is for public relations. Both the industry and the agency need to call attention to the efforts that we're going to make. We need to get the proper media attention of what we're doing. While GMP may be a comfortable term for the industry to use, it may sound like more of the same to the public.

Food safety control point program would convey a cogent way of managing all these individual programs, and critically important programs, which cannot currently legitimately be called HACCP. NTF is continuing work on this issue, but much of our forward momentum has been awaiting this forum and some of the results coming out of it. Much of what I've said is subject to change as we go back to our committee and continue our work.

What I've described is a non-exclusion strategy. As mentioned by the Canadian Government representatives at this forum, it may be possible to move to an exclusion strategy in the future, once we get some experience with all this. We can then perhaps define critical limits, decision criteria, and corrective actions for each test point within the separate programs that I've already discussed.

BIOGRAPHY

Joseph M. Pocius is Director of Scientific and Regulatory Affairs at the National Turkey Federation. Previously he was Manager of Scientific and Regulatory Affairs at the Durkee-French Foods Co. and the R.T. French Co. where his department initiated the HACCP concept for company-wide implementation. He has represented his employers on the Executive Technical Committee of the Grocery Manufacturers of America and on the Executive Technical Committee of the American Spice Trade Association. He holds a B.S. in Zoology from the University of Maryland, a M.S. in Food Science and Technology with emphasis in Food Microbiology from the University of Maryland, and a M.B.A. in Finance, Accounting and Marketing from the William Simon School of Business Administration. He has also attended the Rochester Institute of Technology for Mechanical Engineering.

MS. DONNA REIFSCHNEIDER
CHAIR, PORK SAFETY TASK FORCE
NATIONAL PORK PRODUCERS COUNCIL

SWINE

United States pork producers have long recognized the importance of producing a product in which their domestic and international consumers could have the highest confidence. Consumer assurance of the safety of pork is vital to continued demand for pork. Effectively addressing food safety issues requires a partnership among all of the participants. As the first link in the food chain, pork producers recognize that their actions and production practices have the potential to influence pathogen levels along the rest of the chain. We also recognize that progress made in the area of preharvest food safety can be negated by improper or careless handling in subsequent links of the pork chain. Without question, efforts in the area of food safety need to be well coordinated and should build on previous links in the chain.

Additional research is needed to learn more about the ecology and epidemiology of microorganisms of public health significance before it can be determined where in the food chain is most appropriate for intervention. Much research in the on-farm ecology and epidemiology of potential human pathogens is needed before on-farm food safety systems can be designed and implemented. While the application of Hazard Analysis and Critical Control Point (HACCP) principles is well defined for the food processing industry, its potential application to animal production food safety has not been well researched. It may be more appropriate to discuss food safety control points, reduction strategies or good production practices when addressing food safety at the farm level. The National Pork Producers Council has funded several research projects in animal production food safety and recently issued another request for food safety projects.

A critical concern of producers is what we do in the interim while research is being done, educational information is being developed, improvements are being instituted, yet organisms are traced back to a farm. Clearly, producers need to have feasible control or prevention programs available to them before punitive actions are taken. The Food Safety and Inspection Service has a role in helping to develop the research agenda for pathogen reduction at the farm level and in facilitating technology transfer of research results to the livestock producers.

Pork producers recognize we are the first link in the food chain and we are committed to doing our part to achieve mutual public health goals. We support efforts to look at the production end of the food chain. These efforts must be practical, economically sound, science-based and produce a real, measurable difference.

BIOGRAPHY

Donna Reifschneider is a pork producer from Smithton, Illinois. She runs a farrow-to-finish operation. She also grows corn, soybeans, wheat and milo. She currently serves on the NPPC Board of Directors and Federation Council. She is currently Chairperson of the Pork Safety Task Force. In addition, she is a member of the NPPC Budget Committee, the Industry Budget Committee, and the Consumer Product Marketing Task Force. She has served as co-chair of the Pork Quality Assurance Committee, chairperson of the Information Conference Advisory Committee, and as a member of the Governance Task Force and the World Pork Expo Advisory Board. She has represented the NPPC on the National Live Stock and Meat Board's Youth Initiative Task Force. She was also active in the National Pork Council Women (NPCW) organization, having served on the Executive Committee as a Chairman of the Pork Leadership Institute, the NPCW Conference Membership and Speaker Corps Committees. On the state level, she served as President, Promotion Chairman and on the Education, Membership and Bylaws Committees. Donna also serves on the USDA Committee on Garbage Feeding, the St. Louis Agri-Business Club, and is a member of the Farm Bureau.

MR. JERREL HEATWOLE
PRODUCER

DAIRY/VEAL

Let me say it's good to be here, and I've learned a lot the last two days and today. Just to show you how good and how much I've learned, my brother took seven or eight years to earn the prefix "Doctor". You all have transferred that to me in the matter of two and a half days. Chris, I don't know where the slip-up was, but it's been fun. You can be sure that I'm not a doctor either by profession or education. So, I feel very privileged to be here with you as one of the few producers. In the Dairy/Veal meeting yesterday, the producers were asked to raise their hands, and I was the lone one.

Dr. Buntain challenged us when she outlined her goals for this forum, to envision a day when no one gets sick from meat, milk or eggs. I don't know how many of you have done that over the past couple of days, but I have. It's called heaven, and not only this problem will be alleviated but many others as well. I hope that we can convene a forum such as this there and look back on this time and be amazed at the numbers of wise decisions we could have made if we had the information and knowledge that we most certainly will have then.

Meanwhile, here on Planet Earth, we've got to continue to work toward what Dr. Pierson called acceptable levels of risk. Some of us are at risk more than others. I for one stand here with the risk of elevated blood pressure and heart palpitations, stomach ulcers, and something known as knee-knocking syndrome. Risk is something we all face.

Friday evening, my son David, who will be 12 in nine days, simply lost his balance. He was standing on the edge of a trampoline about 30 inches high, fell backwards, and in a freaky fall, ruptured his spleen. I accompanied him into the emergency room where the nurse in attendance became very belligerent. The minute she heard it was a trampoline he fell off she became belligerent. She did not know any of the facts or circumstances before she made me feel not only negligent as a parent but also directly responsible for his injury.

She went on to talk about her nephew and how she planned to go home and trash their trampoline. I said, "Does your nephew happen to have a bicycle?" Well, she obviously was taken aback and I said, "Well, I certainly hope you transport him about in armored vehicles from place to place".

We have to look at things from a practical standpoint. As a producer, we have some fears or uneasiness at the very least when a topic such as this is brought up and becomes an issue. On one end of the continuum, we're the little guys with the consumers at the other end. I don't know where my physics professor is that told me that for every action there is an equal and opposite reaction. I've noticed that any time there is an action on the continuum that affects consumers, it's not an equal and opposite reaction, but a very multiplied opposite reaction that comes back and tends to sit squarely on the lap of producers.

That's why I say we have a bit of nervousness, and I can illustrate that further in saying that I grow poultry as well. Several years ago I had my serviceman stop by and say, "Jerrel, your chickens will be moved in three weeks, and by the way, we'll not be placing any more chickens in your farm."

For one whose mortgage depends very heavily on the investment I've made in the poultry operation, that was shocking. I asked why. He said, "The last flock which left here approximately 20 weeks ago has been cultured for Salmonella enteritidis." That was news to me. I didn't know anything of that disease, and over the weekend, as I pondered the fate of my family and our farming operation, I decided, well, this is in fact a *de facto* quarantine that's permanent because if this one doesn't want me, the other integrators here on the shore certainly don't want

me. So, I called a meeting with the people the next week. They admitted finally that the problem was not from my farm, but from the layer farm that the flock went to. The layer farm was old and infested with rats. Nobody bothered to tell me they were going to take the quarantine off.

Instead, I had to plead as it were for another chance, for something I had no control over, and I was saddled with a lot of requirements that the rest of the producers weren't saddled with, just because I didn't have the wherewithal to fight it. So, that's the uneasiness and, too, the lack of control the producers face.

When we move animals from our farms, and they go up to three days between then and the processing plant, where the samples are actually taken, we are responsible all the way up to the processing plant. At least when I sell my milk, a sample is taken out of the bulk tank which affords me some level of protection that we don't have with poultry production. I would suggest that we definitely have to get some on-farm tests to solve this kind of problem.

Mr. Taylor has indicated the continuum, and we've heard a lot about it here in food safety, and we readily agree. But the more control one has in determining the end result, the more responsibility one bears. The hazard assessment by the CDC showed that processors had three percent of the problems that were traced back, homes 20 percent, food processors/food service 77 percent. I didn't see anything on the producer end up there. That's not to say that we don't bear any responsibility because we do and, as producers, we take that very seriously.

In our view there is much more control from slaughter to consumers. Greater efficiency and economics can be exerted to get the end result that we're after, from better trimming or steam vacuuming in processing plants to irradiation. Why can't we irradiate all the ground beef? We pasteurize all my milk. That would be one solution.

What is our role as producers in this continuum? We need to continue to improve the quality assurance program and best management practices as applied science, in conjunction with pilot projects and demonstration farms, give us new and better information. I want to commend the TAG Group for their report that recognizes the quality assurance program that we have put in place, and we're willing to build on this.

Best management practices and items that truly affect quality control almost always bring economic benefits to those who employ them. An example is with somatic cell counts. You lower the cell counts, you have better quality milk and increased yield in milk production.

At this point, let me plead for more research. We know so little about many of these pathogens, the ecology, the epidemiology, carrier animals, shedding, and so many of these things that have been mentioned. You all are far more knowledgeable in these areas than I and know more of what needs to be studied first. That has got to be the primary focus, short of heaven, getting this knowledge so that we can make wise decisions.

Any best management practice that's based on poor or incomplete science usually ends up costing us as producers money. A simple illustration is the Staph. aureus organism that causes mastitis. Several years ago, the information was that it could only be transmitted from one cow to another during the milking process. The thought was that you could eliminate herds, have herds free of Staph aureus. I read several articles on culturing and culling these animals and bought into the idea. Recently published articles indicate that heifers are coming fresh with this organism all over the hides, muzzles and different body parts. A lot of money was wasted on something, a best management practice, that was totally impractical and of no use in terms of doing what it was intended to do.

We need to design quality assurance programs and best management practices working back down through the line, step-by-step, person-by-person, from the processor back down to the producers. That will cover every area and then provide for a continuum that can be monitored all along the way.

These procedures need to be voluntary, a product of cooperation, not regulation. They need to be flexible. I'll give you one example. My farm is in Delaware. If I would move it to Harrisonburg, Virginia, I could not ship Grade A milk. I have the highest herd average in the state of Delaware, just under 27,000 pounds of cow on twice-a-day milking. My somatic cell count is at 150,000. My standard fleet count has been under 2,000, PIC count under 1000. But that would not be good enough for Grade A if I were in the state of Virginia. We need to design management practices that are flexible for different areas as long as we get the end result. I must say that in the 11 years I've been on the farm, I have yet to have an antibiotic violation or bacterial violation or a meat violation. People need to work within systems that are flexible enough to allow for education and adaption. History shows that when farmers are educated and see real benefits, based on scientific knowledge, they adapt rapidly to technology or new practices.

As a father and uncle on a farm, I often have close to 30 children under the age of 13. Many times I can count over 20 children playing in the yard, including neighbors, children, and cousins. I'm concerned about their safety and welfare, and we eat our own meat and cull cows. We drink our own milk. We kill the occasional chicken that the integrator leaves behind and eat that as well, and I think that risk is something that we all need to take seriously. We all need to take personal responsibility.

I share with you concern over the incident last November. I was in Dallas at a meeting, and I went downtown and sat in this little joint and ordered a hamburger. It was lunchtime, and right on the menu it said "USDA requires us to cook hamburgers well done. This in our view spoils the flavor, but we're required to do so unless you request otherwise."

Well, I didn't request otherwise, but when I bit into my hamburger it was pink in the middle. Now, I must tell you that I went on ahead and ate that hamburger, but I ate it under the knowledge of what I was working with. We all need to take those kinds of responsibilities, and if we try to not be responsible for ourselves and those near us, we do ourselves and them a disservice.

In summary, I would say that first, from our perspective we need research, research, research. You all know much better than I the areas that need research, so I depend on you to determine that.

Second, we need to continue to build on current quality assurance and best management practices and not HACCP. HACCP has to be totally science based. We don't have the controls of the science to do that in a farm environment, especially where there's so many different variables, so many different farms, different conditions, different types of farms, and on and on and on. Best management practices and quality assurance programs definitely have a place. Many producers have already shown a willingness to go that direction. I don't see a problem with us building on that.

Third, we need to cooperate instead of regulate. Cooperation encourages innovation. It encourages feelings of feedback and trying to improve where regulation tends to stifle, stagnate and shut down our desires and our impetus to change and to do better. These areas would be my biggest recommendations to this group, to FSIS.

Let me close by giving some food for thought. You all are an exceptional group, knowledgeable and concerned about animal production and food safety. I believe Dr. Buntain when she says that the recommendations from this forum will greatly influence animal production agriculture as it relates to food safety.

This group and the ideas that have been presented here directly affect me as a producer, and the way I make a living and the way my family survives. I can only count one, two, or three producers here in this group. Producers can give insights and perspective of how it is on the farm and the things we've got to work with. Put you in our moccasins, so to speak. I don't know how many of you know what it is to operate a farm at this time of the year. Since I got up early Monday morning till this point in time and until late tonight when I finally reach the bed, I

will have had nine hours of sleep, so there's a lot of stress. There are many factors that we need to consider when we look at these things. I think as producers we can offer some insight to your expertise and channel it better, not change it.

You know, once this train gets rolling, it's awful hard for the processors to grab hold, much less stop it or change direction or redirect it. It's virtually impossible. It's incumbent on this process to have meaningful producer reviews or not just input after the whole thing is pretty well been put in place because by that time, we don't know where or what the meanings or why. We haven't been included, and it's hard to sit down and look at—read as John Adams floods me with pages and pages of federal regulations and documents I'm supposed to read at my leisure, and offer meaningful comments.

It's very difficult, where if I can be here and feel the pulse and hear and begin to understand some of the things, it's a lot more easy for me to provide meaningful recommendations or directions or insights or so on.

So, I think it's incumbent on this process to have meaningful producer reviews, just as you have peer reviews in research and in other things in your various organizations that can have a real impact on this process, making it more effective in accomplishing food safety goals for all of us.

BIOGRAPHY

Jerrel Heatwole is a young farmer. Along with his wife Alma and four children, he maintains a 250-acre farm with 70 milk cows and a 650-foot poultry house.

Jerrel has been involved in the Milk Cooperative since 1986 and became Director in 1990. Currently, he is on the board of the newly formed Milk Marketing, Inc., the Nations third largest Dairy Corporation. He is also Director for Eastern Best Products, Inc., Middle Atlantic Milk Marketing Association, and the National Milk Producers Federation.

DR. BOB SMITH

BEEF CATTLE

I am going to speak on the present and future perspectives as it relates to beef, and I thought we would take this opportunity to make a few comments about the beef industry and compare it in a general way to the other industries that are represented here today.

The beef industry is not nearly as integrated as some of the other industries, such as poultry and swine, and I know that there's a lot of variation within each commodity group. We have nearly one million producers and a lot of our beef cattle producers are part-time operators. It is an industry which has high-cost inputs, primarily because of land prices. In addition, there is a significant time interval between when the cow is bred and the calf is sold for grazing or feeding purposes. In summation, the turnover in the dollars is slow, there is a high capital investment and it is a rather low-profit industry, but it is a very important industry as we look at it on a national basis.

Biosecurity has been addressed in many of the presentations. In the beef industry, there are three segments contributing to beef production: cow-calf, stocker operations and feedlots. Granted, there are those that retain ownership through retained ownership or strategic alliance programs, but most calves change ownership several times. The weaned calf may go through a backgrounding operation, a stocker operation for grazing, to a feedyard and finally to the packer. This animal will be handled or seen by several hundred people in the packing house and finally goes to the distributors, retailers and so forth. So, as we think about microbial hazards, there are lots of opportunities for exposure to pathogens, contamination and so forth.

Sanitation has also been addressed. Beef cattle spend most of their lives on ranges or pastures, but in feedyards they live on a dirt environment. What we find interesting is that the incidence rate of *E. coli* O157:H7 shed from cows on nice "clean" pastures is very similar to what we find in the feed yard, where cattle live on dirt. I don't believe a microbiologist would appreciate the use of the term "sanitizing", but the feedyard industry spends literally millions and millions and millions of dollars each year in properly maintaining their pens. This is a management practice which the feedlot operator finds beneficial to the cattle, and it fosters a better relationship with folks like Dr. Allen at the packing house. Keeping the cattle cleaner reduces the amount of foreign body contamination that the packers have to deal with.

I would also like to address what the industry is doing to address food safety, and how it is organized. First, we have listed here the National Cattlemen's Association's Beef Quality Assurance (BQA) Task Force. This task force has been active for many years. Incidentally, the chair of this task force is Dr. Ran Smith, a veterinarian who owns and manages a feedyard in Western Kansas. Dr. Smith had to leave this meeting a few moments ago.

The NCA Beef Quality Task Force is currently divided into several committees. We have a pre-harvest food safety committee. In addition, there is a quality and consistency committee, which is seeking ways to reduce quality defects that we see in beef products, Specifically, they are looking for ways to reduce quality defects that may have been caused during the stocker stage or in the feedyard.

There is also a residue avoidance committee. The fed-cattle, or feedlot industry, can be extremely proud of the track record that they have established in residue avoidance. You virtually never see a residue in cattle coming out of the feedyard to the packer. This is because industry-driven residue programs have been developed and they are being followed. Most stocker and feedyard residue avoidance programs follow a HACCP-type of format..

The last committee is also extremely important. This one is called "program implementation." This takes the national program to the state level. We think this is very important. State cattlemen's affiliates are involved in

these beef quality programs, addressing most of the same issues addressed by the NCA. About 40 of the states do have these beef quality assurance programs going. Many of the smaller states do not have many beef cattle and, while not addressing these issues on the state level, can depend upon the national program.

On the dairy side, we have the Milk and Dairy Beef Quality Assurance Program, commonly called the 10-point program. It has been very effective on the dairy side. Other organizations that have been working together on food safety issues include the AVMA Food Safety Committee and the American Association of Bovine Practitioners (AABP) Food Safety Committee. The AABP works very closely with the Academy of Veterinary Consultants, a group of veterinarians who consult with the feedyards throughout the United States.

As Jim Sears mentioned earlier today, our beef quality assurance programs are targeted towards the needs of the consumer. The BQA programs are not targeted towards animal production enhancement. We're looking at the quality and the safety of the product that we are producing. In some cases, a program that improves beef quality and beef safety might also improve production efficiency. If it does, that's a plus for the program. Also, the NCA, as mentioned yesterday, sponsors the Total Quality Management (TQM) program for feedyards. These programs are designed to improve the quality of the inputs, which is important to both consumers and producers. When we improve the quality of our assets and inputs, hopefully we will improve the quality of our output or final product.

The cattle industry is also very involved in supporting research directed towards food safety. The NCA and other beef organizations have supported about $4 million worth of research to attack the O157:H7 problem. This includes both pre-harvest and post-harvest food safety initiatives. This is the cattlemen's money!

The state cattlemen's affiliates have been providing research grants at various levels to the land grant institutions within their states. As Dr. Gillespie said, "These research dollars, public or private, seem to be more and more difficult to obtain. We have future commitments for researching food-borne hazards as soon as money becomes available."

Next, I would like to discuss research recommendations or needs. I want to emphasize that it has become quite obvious during this forum that we have a long way to go to understand what can be done to improve food safety through control of microbiological hazards. The National Livestock and Meat Board's Blue Ribbon Task Force has published several research priorities.

This report emphasizes the need to continue to conduct research and obtain more data regarding the host-pathogen relationship between cattle and the O157:H7 organism. We need to identify the factors outside the bovine reservoir that contribute to the prevalence of the O157:H7 and other pathogens, and the maintenance of contamination. I'll mention just a few things. Others have talked about birds, farm pets, perhaps even people. We know that a lot of past food-borne outbreaks in the past have been related back to shedding by humans. We don't know what the situation is with pathogens such as O157:H7. We don't know how it survives outside the host. It is interesting that a lot of culture-positive animals are negative upon subsequent cultures. It does seem to circulate through cattle groups. How does it do that? How does it maintain itself in the herd? And how do cattle transportation systems contribute to the spread of the O157:H7 and other pathogens?

We need to establish and maintain an industry-driven food safety information center, a clearinghouse, if you want to call it that, so that we know what research the federal government is doing, as well as what research is being done at universities and by commodity groups.

We need to continue to review epidemiological studies and conduct new ones. Foodborne pathogens with a low incidence rate, such as O157:H7, present a major challenge to epidemiologists as they attempt to define critical control points. It would be easier to make progress if we had a 90-percent incidence rate, because if we instituted

a control and the incidence dropped to 50 percent, progress is readily apparent. Then we look for the next step or control point. I'm not an epidemiologist, but those of you with epidemiological training have a real challenge to learn the control points for a problem that affects about one percent of the animals or is found on one percent of carcasses. I see this as a major hurdle for making progress.

The Blue Ribbon Task Force has expressed the need to standardize methods of sampling and culturing O157:H7. In April of this year, an article in a scientific journal suggested that the incidence rate of O157:H7 in cattle populations may be slightly higher than previously reported, not because the problem is getting worse, but rather because scientists are becoming better at recovering the organism through enrichment techniques. So if you see a published incident rate of two percent, and you are accustomed to a one percent rate, don't think it necessarily means the problem is worsening but, rather, we're doing a better job of finding the organism.

Culturing techniques need to be standardized. This would allow us to read articles written by various researchers and know that they are all using the same methods of recovery and reporting.

Now I'd like to discuss our current understanding of animal production HACCP. Where are we today? Where do we need to go? We've talked about needed research, which is of paramount importance for tackling this problem. We know what the hazards are, so the hazard analysis is pretty obvious. We talked about the problems associated with O157:H7, *Salmonella*, *Listeria* and *Campylobacter*. But the critical control points for the animal production HACCP programs are generally lacking.

Let's talk about what little we know about critical control points. Let's consider downer cows, which, by the way, need to be eliminated from the food production system. Perhaps downer cows have a lower incidence rate than cows that are up on their feet and looking healthy. I don't know that. I don't think any of us do. But this is an example of things that we need to look at and realize that, at present, we do not know any critical control points,.

Without these control points, or management points, animal production HACCP programs cannot succeed. It is extremely important that we do not promise the public, the consumer, a preharvest food safety program without known critical control points. If we promise the consumer something that we cannot deliver, we will lose consumer confidence. We would give them a false sense of security. Perhaps some consumers who enjoy eating their ground beef medium rare may start eating it that way again, having confidence in a food safety program that is not scientifically sound.

We must continue to do research to learn more about foodborne pathogens. Research should provide the basis for implementing animal production HACCP-type programs, or good management practices if you prefer that terminology. From what I understand today about foodborne microbial hazards, it is not likely that animal production HACCP-type programs by themselves are going to eliminate microbial hazards in beef. It's going to be part of an overall program. This program includes pre-harvest and post-harvest food safety programs, food handler education, consumer education, and so on.

I think I can safely say, because of my involvement with NCA, AABP, and the AVMA, that the beef industry does stand ready to adopt and to implement management and technologies that research has shown will improve the safety of the nation's beef supply. I do think that the poultry, egg, dairy, beef and pork industries have a track record that says that industry-driven programs can work and many times they are more cost effective than government programs.

Finally, in closing, I would like to compliment Al on his presentation this morning. Al, while I was sitting over there on the edge of the stage, I was wondering for awhile if you're going to give an altar call. Had you done that, I would have come forward. Thank you.

BIOGRAPHY

Dr. Bob Smith is currently involved in beef cattle extension and conducts research at the Pawhuska Research Station in Oklahoma. He spent a few months in private practice before assuming a large animal internship in the Department of Medicine and Surgery at Oklahoma State University. Until 1990, he was a field services clinician in the Large Animal Clinic and became Co-Director of the Pawhuska Research Station. During 1990-91, he worked as a feedyard consultant with Palo-Duro Consultation. Dr. Smith has presented numerous lectures and seminars at local, state, and national meetings. He received the Norden Distinguished Teacher Award in 1983.

Dr. Smith received his B.S. and M.S. in Animal Science and a D.V.M. degree from Kansas State University. He is a Diplomate of the American Board of Veterinary Practitioners. His professional memberships include the AVMA, ASBP, Kansas and Oklahoma VMA, Academy of Veterinary Consultants, and the National and Oklahoma Cattlemen's Associations. He served as AABP Director, Vice President, and President elect from District 7, and has been President since September 1994. He was a Food Animal Regent of the American Board of Veterinary Practitioners from 1986 to 1991.

APPENDIX A
USAHA Resolution

USAHA RESOLUTION

United States Animal Health Association Resolution Supported at the National Forum on Animal Production Food Safety, May 23, 24 and 25, 1995.

The successful planning, implementation, and evaluation of effective, industry-compatible animal production (preharvest) food safety programs requires regular, ongoing discussions between industry, state and federal agencies, the scientific community and consumers within a framework of a science-based national forum recognized by all parties.

The USAHA is a science-based, problem-solving national forum representing animal and allied organizations, state and federal animal health and public health agencies, the scientific community and consumers. USAHA has a 99-year history of successful planning, implementation and evaluation of animal health and public health programs, such as tuberculosis, brucellosis, pseudorabies and avian influenza control.

The USAHA has long maintained active committee work in the area of food safety and public health. At the 98th Annual Meeting (1994) the membership passed a resolution recommending that USAHA serve as the nation's national forum for pre- and postharvest food safety.

Therefore be it resolved that a committee appointed by the USAHA president be activated and used as a mechanism through which ongoing dialogue and discussions can be held on the food safety issue. The USAHA should participate in the planning and subsequent implementation and evaluation of any proposed preharvest food safety initiative.

APPENDIX B

Dr. Gangarosa's Tables

Table 1: A Ranking of Acute Human Health Effects Of Infectious Agents Transmitted by Food in the United States

Hazard	Effect	Incidence	Impact Score	Ranking
Bacterial				
Arcobacter	2.3	1.8	4.1	13
Bacillus cereus	2.2	2.2	4.8	11
Campylobacter jejuni/coli	3.8	4.0	15.2	1
Clostridium botulinum	4.0	1.5	6.0	8
Clostridium perfringens	1.8	3.0	5.4	10
E. coli O157:H7	3.8	3.0	11.4	2
Other SLTEC	3.3	2.0	6.6	6
Other *E. coli*	2.3	3.0	6.9	5
Listeria monocytogenes	3.5	2.0	7.0	4
Salmonella (non-typhoid)	3.8	4.0	15.2	1
Shigella	3.2	2.0	6.4	7
Staphylococcus aureus	2.8	3.0	5.6	9
Vibrio cholerae	3.5	1.0	3.5	15
Vibro parahemolyticus	2.3	2.0	4.6	12
Vibro vulnificus	4.0	1.0	4.0	14
Other Vibrio spp.	3.2	1.0	3.2	16
Yersinia enterocolitica	3.2	2.0	6.4	7
Parasitic				
Cryptosporidium	2.5	1.0	2.5	17
Giardia	2.5	1.0	2.5	17
Taenia saginata	1.5	1.0	1.5	18
Taenia solium	1.5	1.0	1.5	18
Toxoplasma gondii	3.2	3.0	9.6	3
Trichinella spiralis	3.2	2.0	6.4	7
Viral				
Hepatitis A	2.8	2.0	5.6	8
Norwalk/Norwalk-like	2.0	3.3	6.6	6

Table 2: A Ranking of Chronic Human Health Effects Of Infectious Agents Transmitted by Food in the United States

Hazard	Effect	Incidence	Impact Score	Ranking
Bacterial				
Arcobacter	2.5	1.0	4.5	8
Bacillus cereus	1.0	1.0	1.0	14
Campylobacter jejuni/coli	3.8	10	3.8	4
Clostridium botulinum	3.2	1.0	3.2	7
Clostridium perfringens	1.0	1.0	1.0	14
E. coli O157:H7	4.0	1.5	6.04	2
Other SLTEC	3.2	1.0	3.2	7
Other *E. coli*	2.0	1.0	2.0	10
Listeria monocytogenes	4.0	2.0	8.0	1
Salmonella (non-typhoid)	4.0	2.0	8.02	1
Shigella	3.3	1.0	3.3	6
Staphylococcus aureus	1.0	1.0	1.0	14
Vibrio cholerae	1.0	1.0	1.0	14
Vibro parahemolyticus	1.0	1.0	1.0	14
Vibro vulnificus	4.0	1.0	4.0	3
Other Vibrio spp.	1.0	1.0	1.0	14
Yersinia enterocolitica	3.5	1.0	3.5	5
Parasitic				
Cryptosporidium	1.8	1.0	1.8	11
Giardia	1.5	1.0	1.5	12
Taenia saginata	1.2	1.0	1.2	13
Taenia solium	4.0	1.0	4.0	3
Toxoplasma gondii	4.0	2.0	8.0	1
Trichinella spiralis	3.5	1.0	3.5	5
Viral				
Hepatitis A	2.3	1.0	2.3	9
Norwalk/Norwalk-like	1.0	1.0	1.0	14

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